Kankakee River Flood and Sediment Management Work Plan
Interim Findings and Recommendations for Indiana

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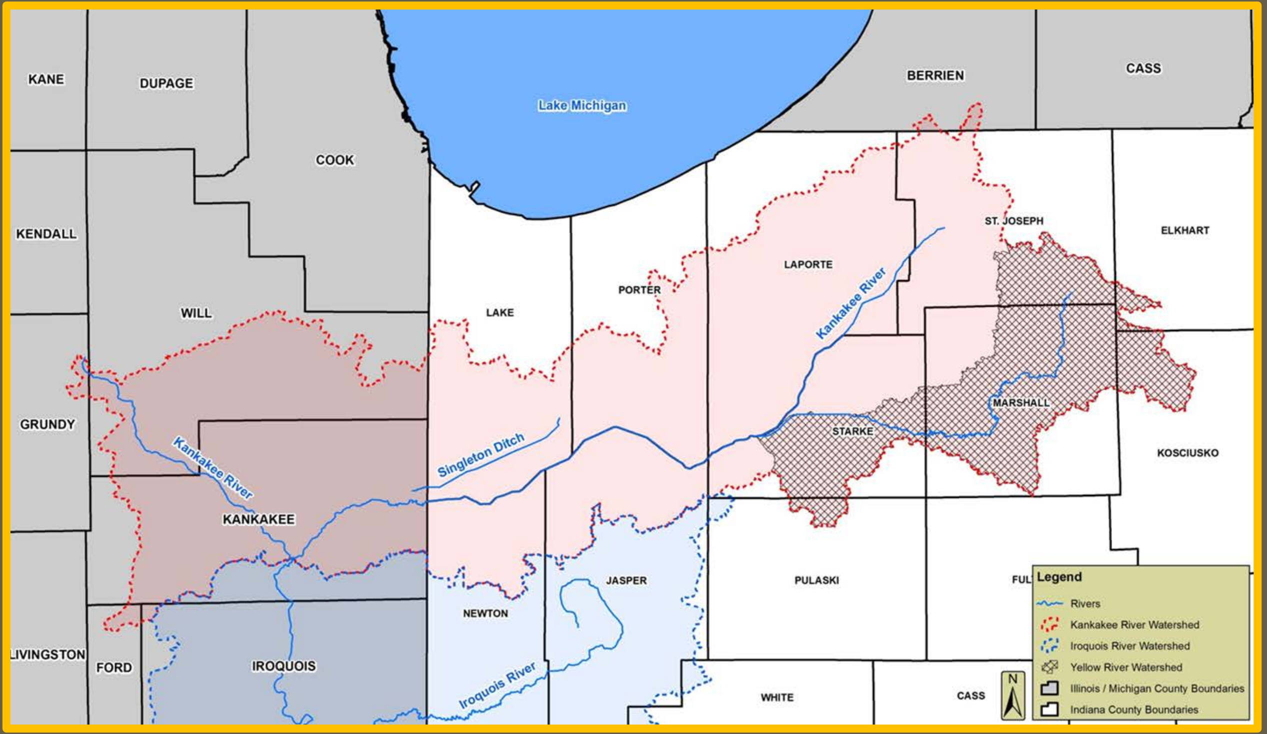
Kankakee River Erosion, Sediment, and Flood Risk Management Work Plan

– **Diagnose** the Root Causes of Erosion, Sedimentation, and Flooding through Detailed Field and Desktop Assessment

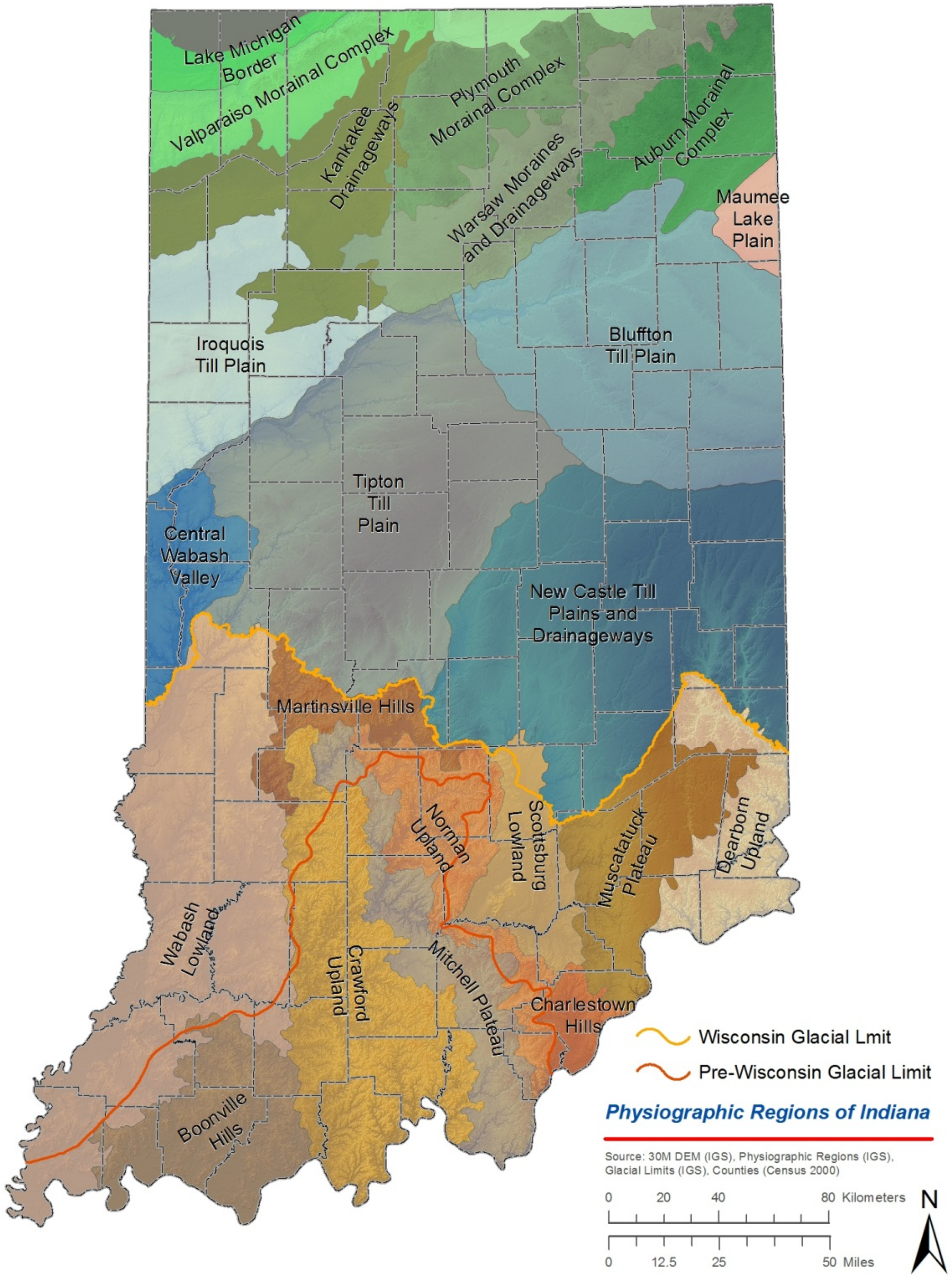
– **Communicate** the Extent of Existing Risks and Expected Trends (Changing Climate)

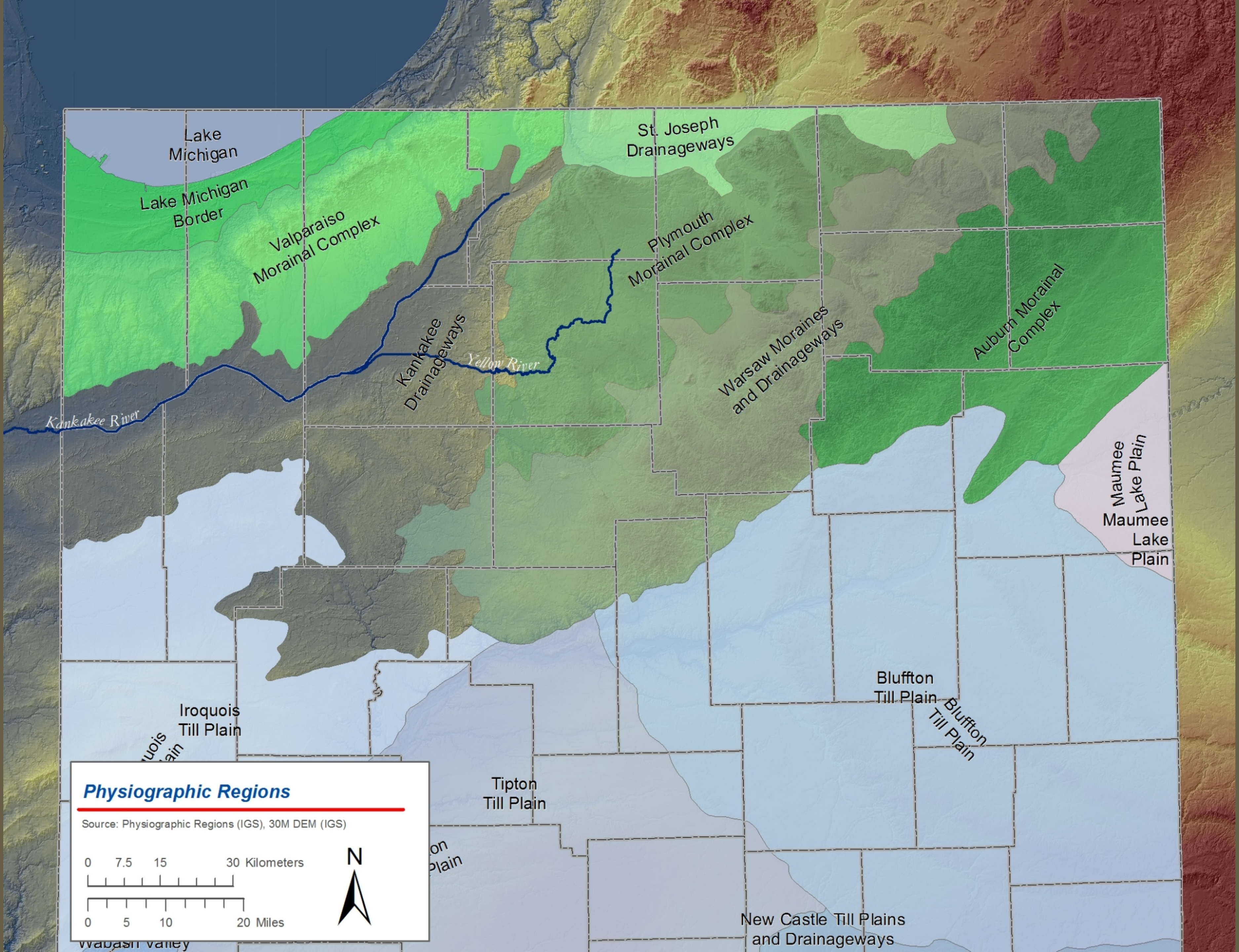
– **Identify** Strategies for Addressing the Issues in a System-wide Approach

– **Develop** a Work Plan for Implementing Various Strategies Specific to Each Area Within the Watershed (Main Stem Reaches, Laterals, Urban Areas, Ag Areas)

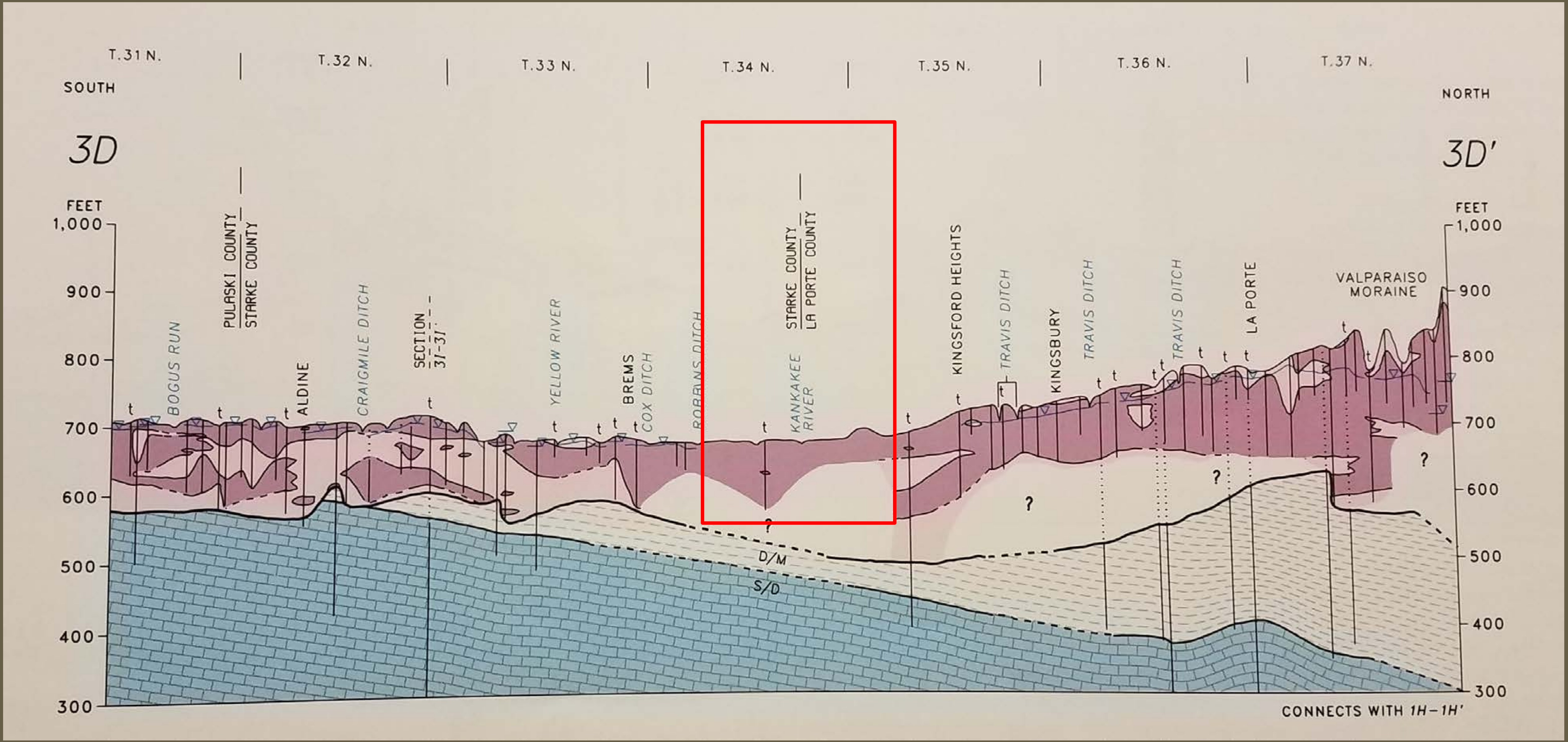


A Joint Indiana – Illinois Effort to Address a Legacy Problem Facing Both States!

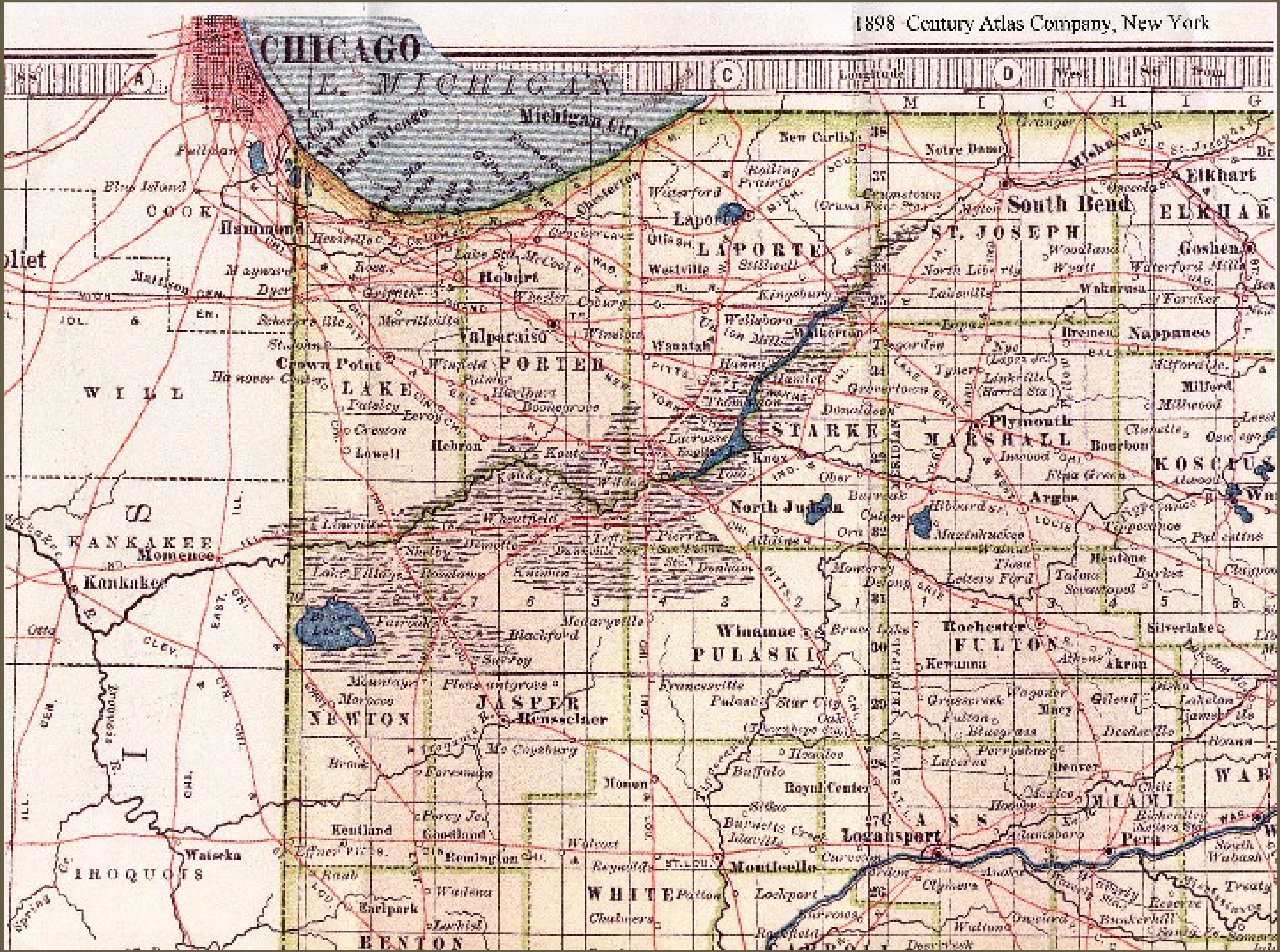

Lake Michigan Border
Valparaiso Morainal Complex
Kankakee Drainageways
Plymouth Morainal Complex
Warsaw Moraines and Drainageways
Auburn Morainal Complex
Maumee Lake Plain
Iroquois Till Plain
Bluffton Till Plain
Tipton Till Plain
Central Wabash Valley
New Castle Till Plains and Drainageways
Martinsville Hills
Norman Upland
Scottsburg Lowland
Muscatatuck Plateau
Dearborn Upland
Wabash Lowland
Crawford Upland
Mitchell Plateau
Charlestown Hills
Boonville Hills
Wisconsin Glacial Lmit
Pre-Wisconsin Glacial Limit
Physiographic Regions of Indiana
Source: 30M DEM (IGS), Physiographic Regions (IGS), Glacial Limits (IGS), Counties (Census 2000)
0 20 40 80 Kilometers
0 12.5 25 50 Miles
N



Lake Michigan
Lake Michigan Border
Valparaiso Morainal Complex
St. Joseph Drainageways
Plymouth Morainal Complex
Kankakee Drainageways
Yellow River
Kankakee River
Warsaw Moraines and Drainageways
Auburn Morainal Complex
Maumee Lake Plain
Maumee Lake Plain
Bluffton Till Plain
Bluffton Till Plain
Iroquois Till Plain
Tipton Till Plain
New Castle Till Plains and Drainageways
Wabash Valley
Physiographic Regions
Source: Physiographic Regions (IGS), 30M DEM (IGS)
0 7.5 15 30 Kilometers
0 5 10 20 Miles
N

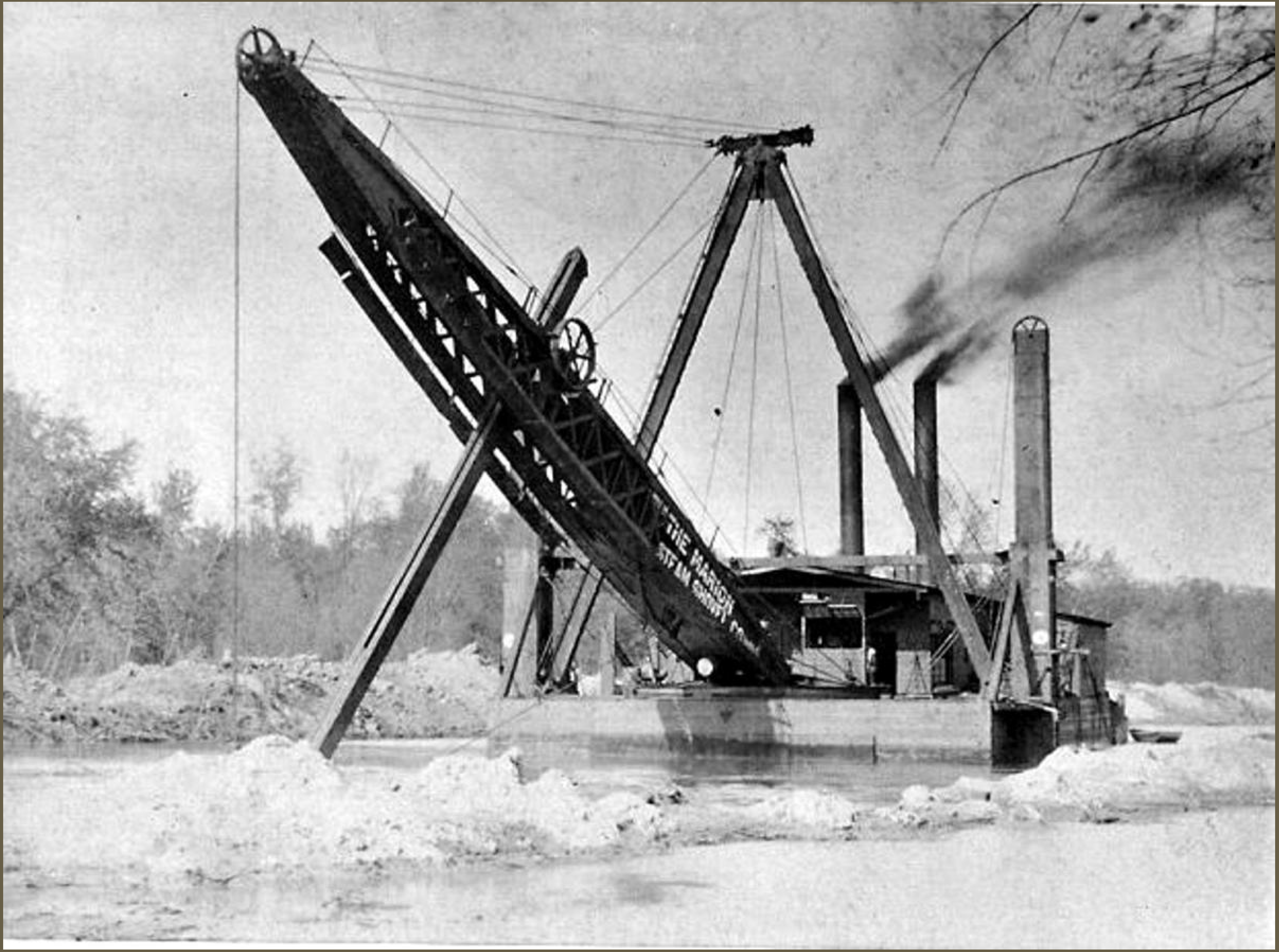


Hydrogeologic Atlas of Aquifers in Indiana, USGS, 1994

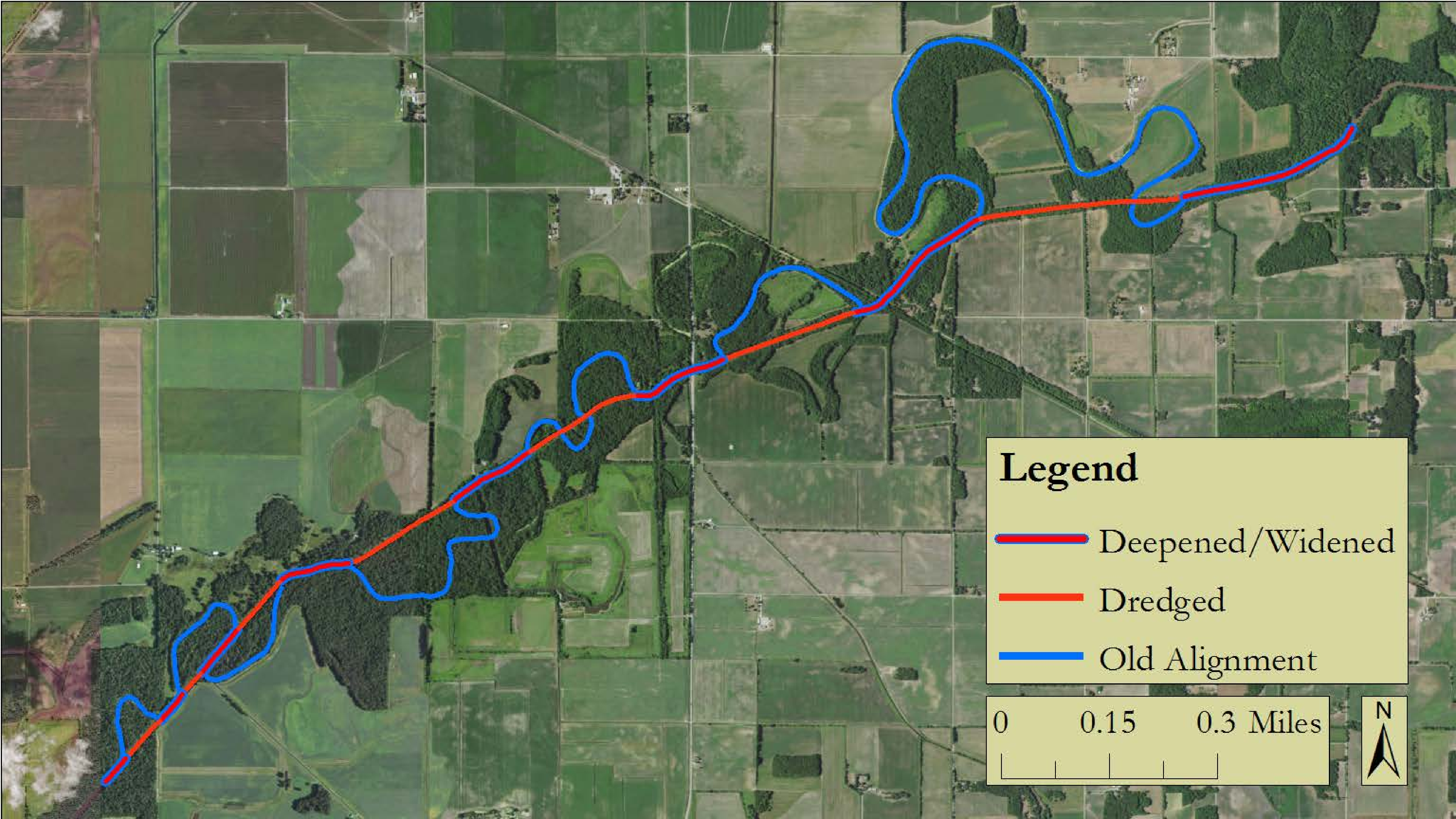


1898 Century Atlas Company, New York

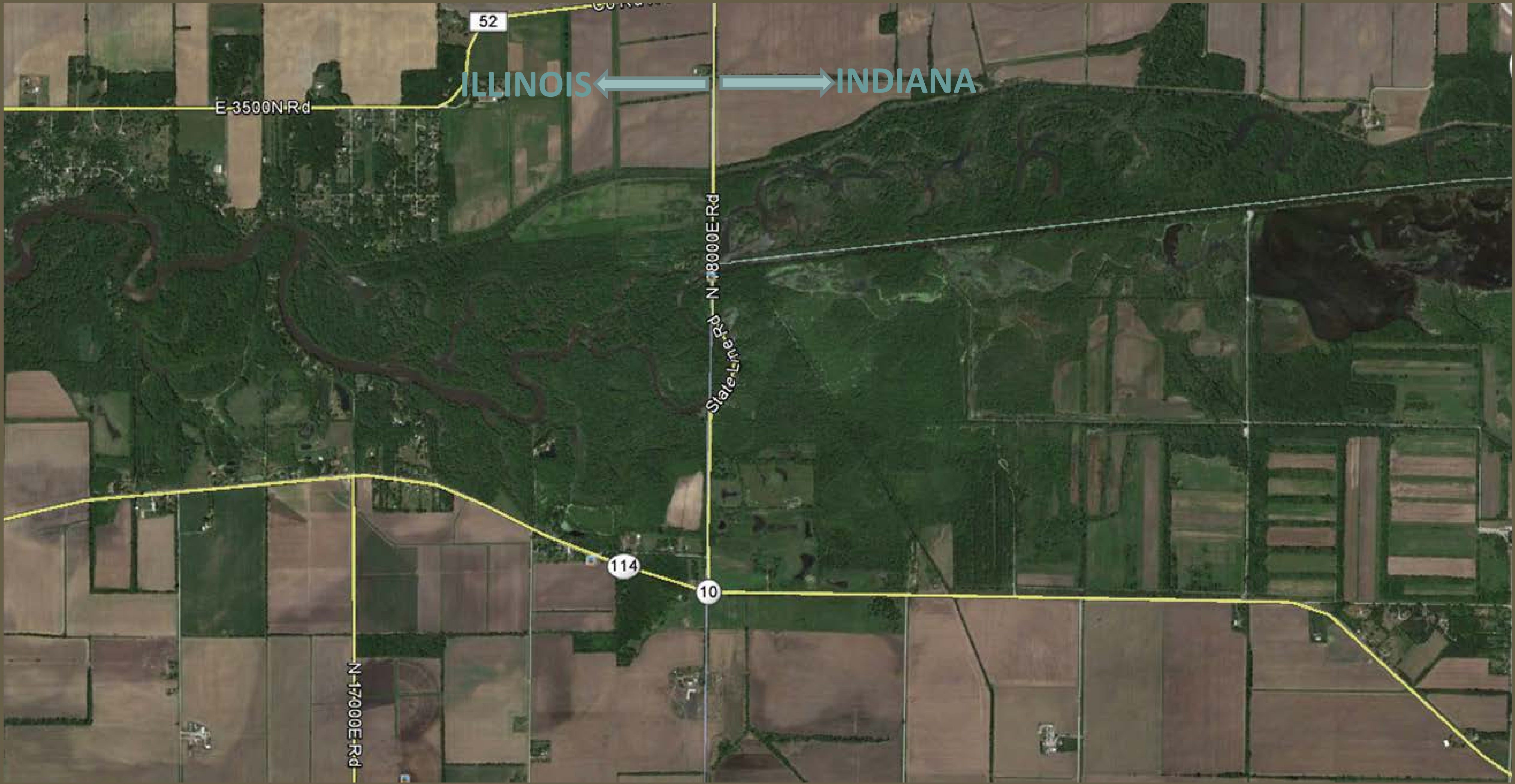
Kankakee River in St Joseph County -Walkerton Area Historical Society

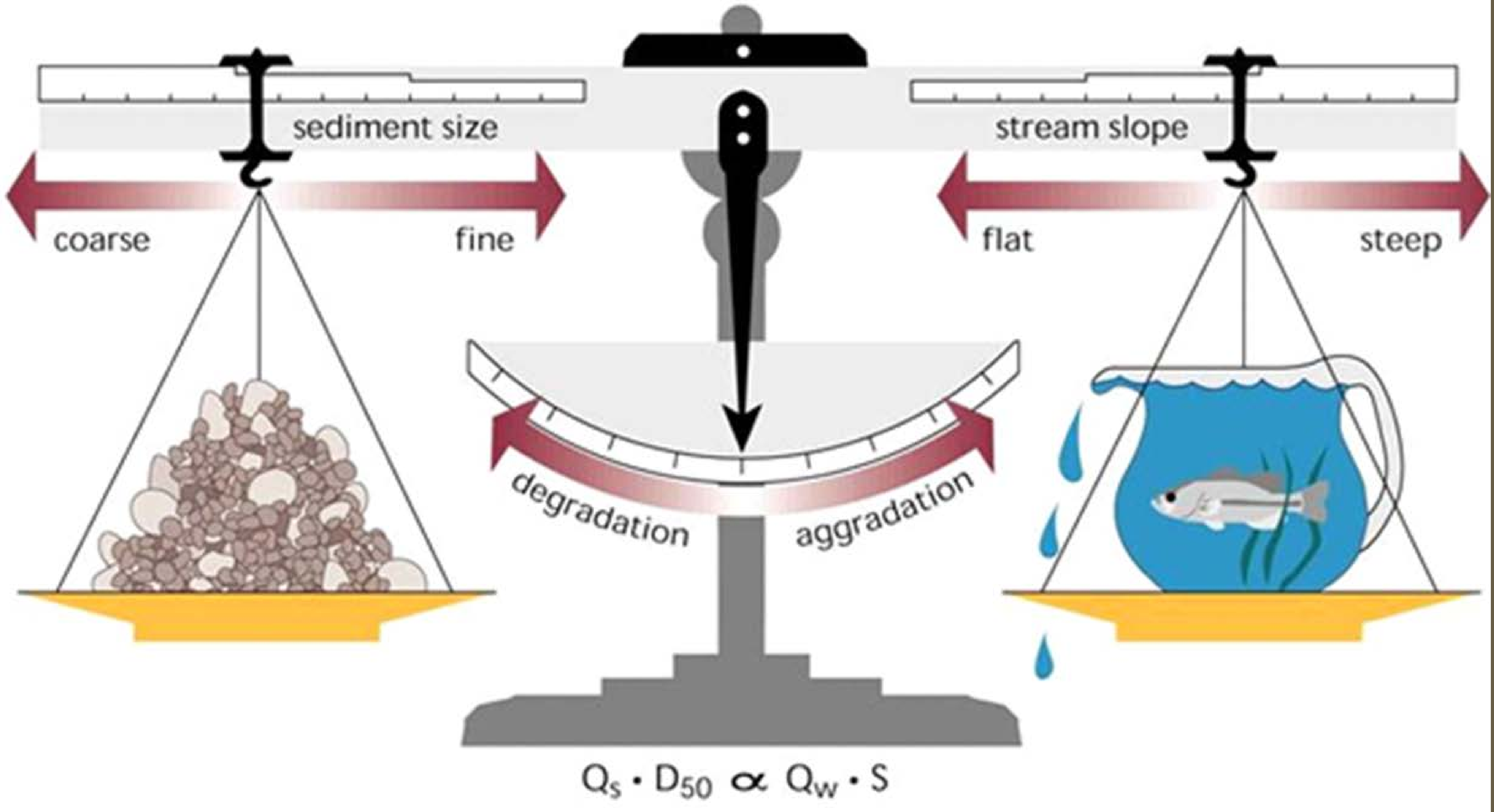


(Kankakee Valley Historical Society)


Legend
Deepened/Widened
Dredged
Old Alignment
0
0.15
0.3 Miles
N

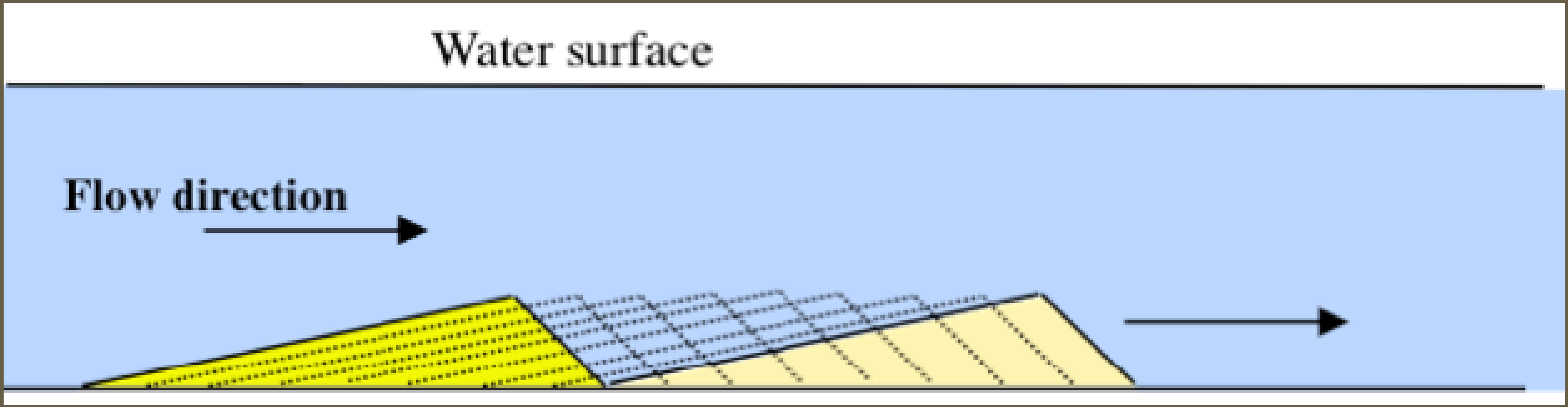
Photo, Northwest Indiana Genealogical Society Collection


ILLINOIS
INDIANA
52
E-3500N Rd
N-18000E-Rd
State-Line-Rd
114
10
N-17000E-Rd

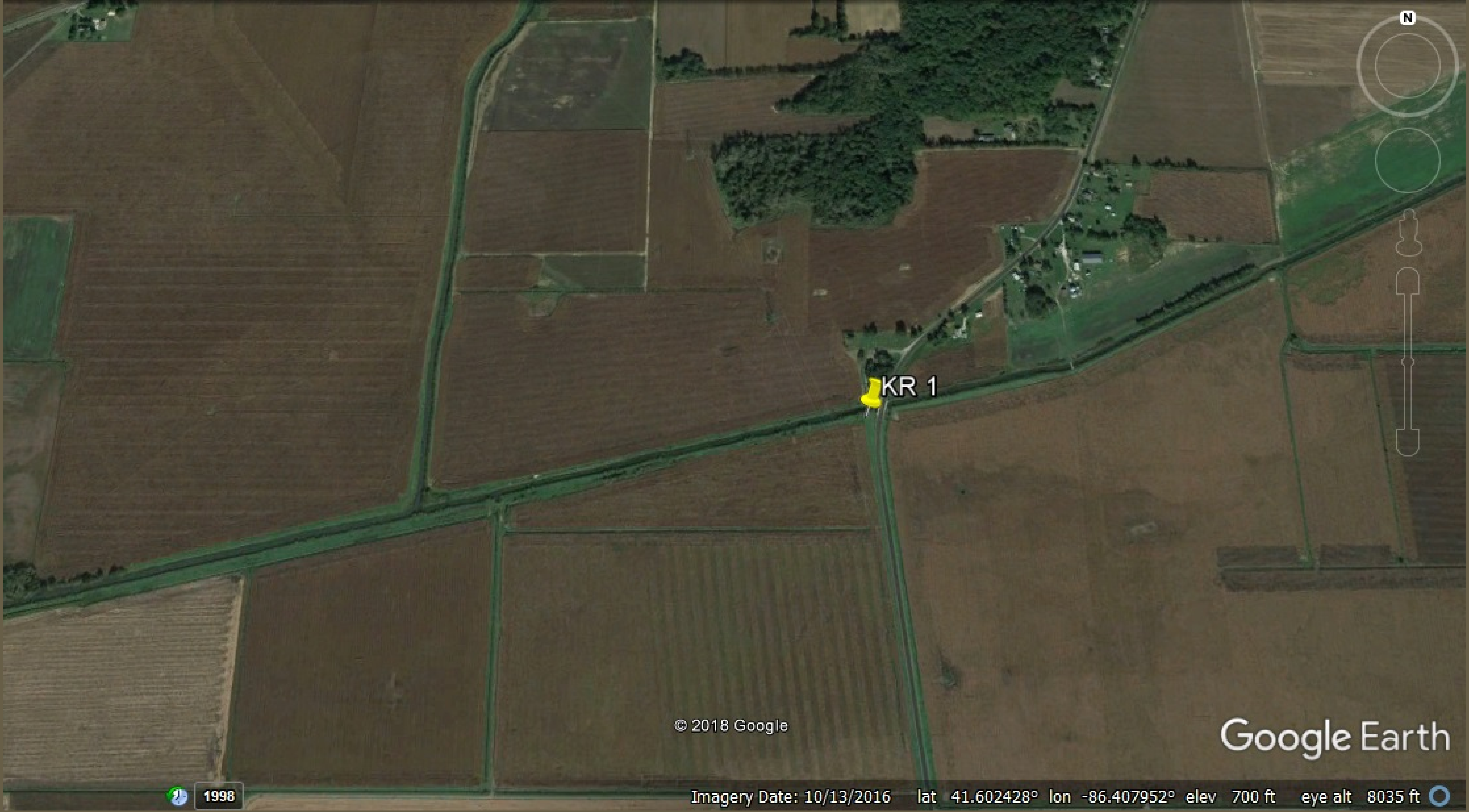


Wildland Hydrology, after Lane, 1955

Platte River near Wood River, NE

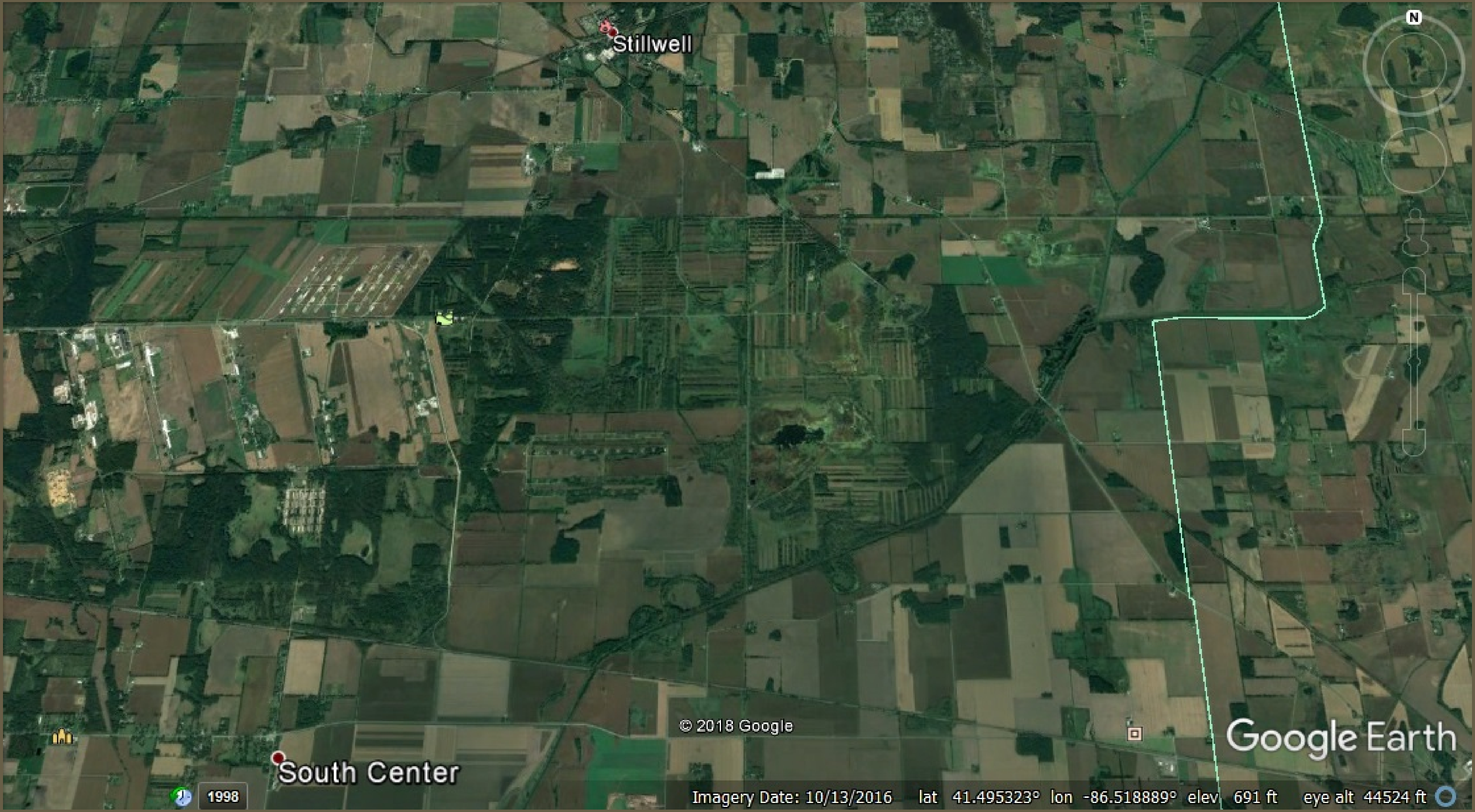


Sand waves translating downstream (Hickin)



Kankakee River at Crumstown Highway, St Joseph County

Kankakee River, St Joseph County



Kankakee River at Kingsbury Fish and Wildlife Area, LaPorte County

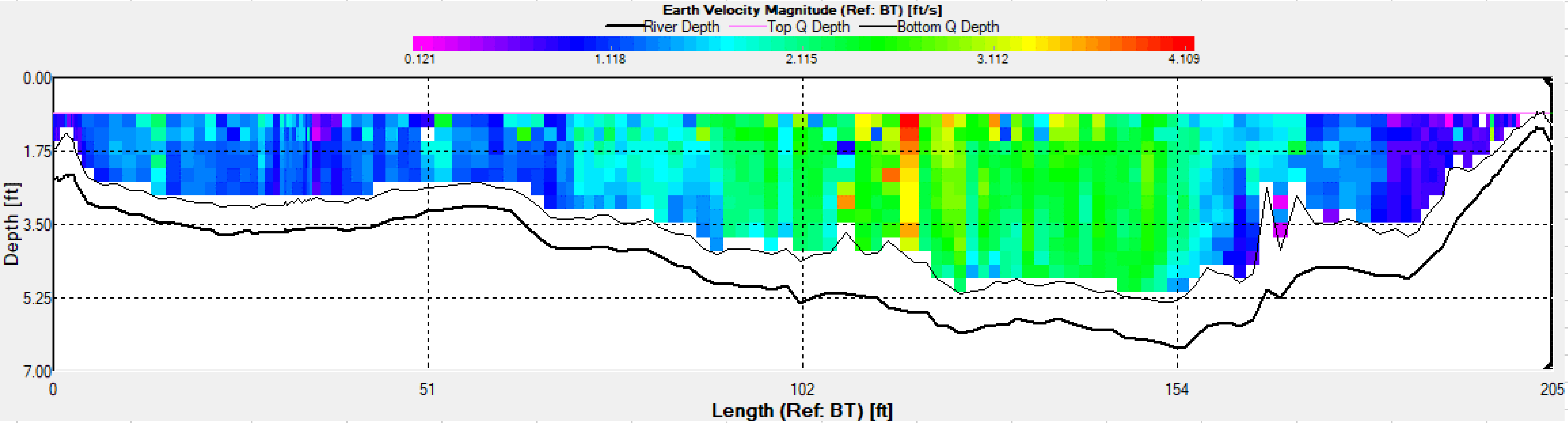
Kankakee River at Kankakee Fish and Wildlife Area, LaPorte and Starke Counties

Yellow River at Kankakee Fish and Wildlife Area

Kankakee River at Kankakee Fish and Wildlife Area

Kankakee River at Yellow River, LaPorte and Starke Counties

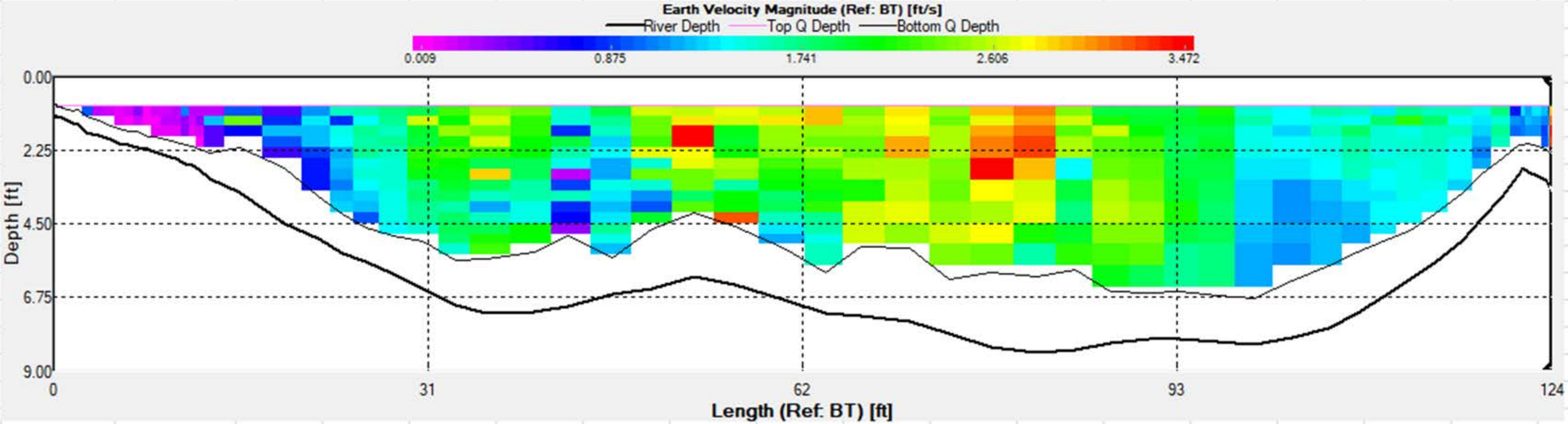
Transect #	Latitude	Longitude	Cross Section Area	
1	41.27118839	-86.82682232	697	sq feet



Kankakee River at confluence with Yellow River, Hanna Arm, and Kline Arm

Measured Channel Dimensions		Predicted Bankfull Channel Dimensions
Area	= 669 ft^2	= 575 ft^2
Width	= 177 ft	=129 ft
Mean d	= 3.78 ft	= 4.4 ft
Max d	= 6.3 ft	= 5.25 ft

Transect #	Latitude	Longitude		Cross Section Area	
6	41.26723149	-86.84668586		714.68	sq feet

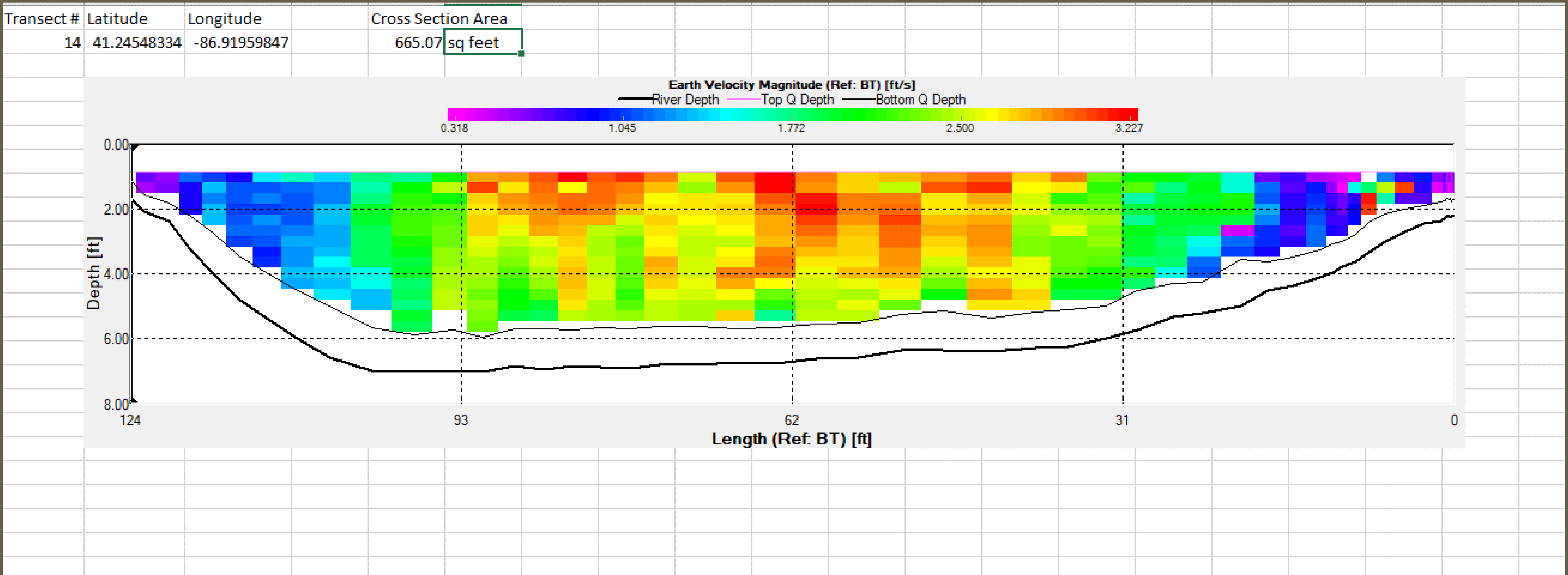


Kankakee River below confluence with Yellow River, Hanna Arm, and Kline Arm

Measured Channel Dimensions		Predicted Bankfull Channel Dimensions
Area	= 485 ft^2	= 577 ft^2
Width	= 105 ft	=130 ft
Mean d	= 4.62 ft	= 4.4 ft
Max d	= 8.0 ft	= 5.25 ft

Kankakee River, LaPorte County

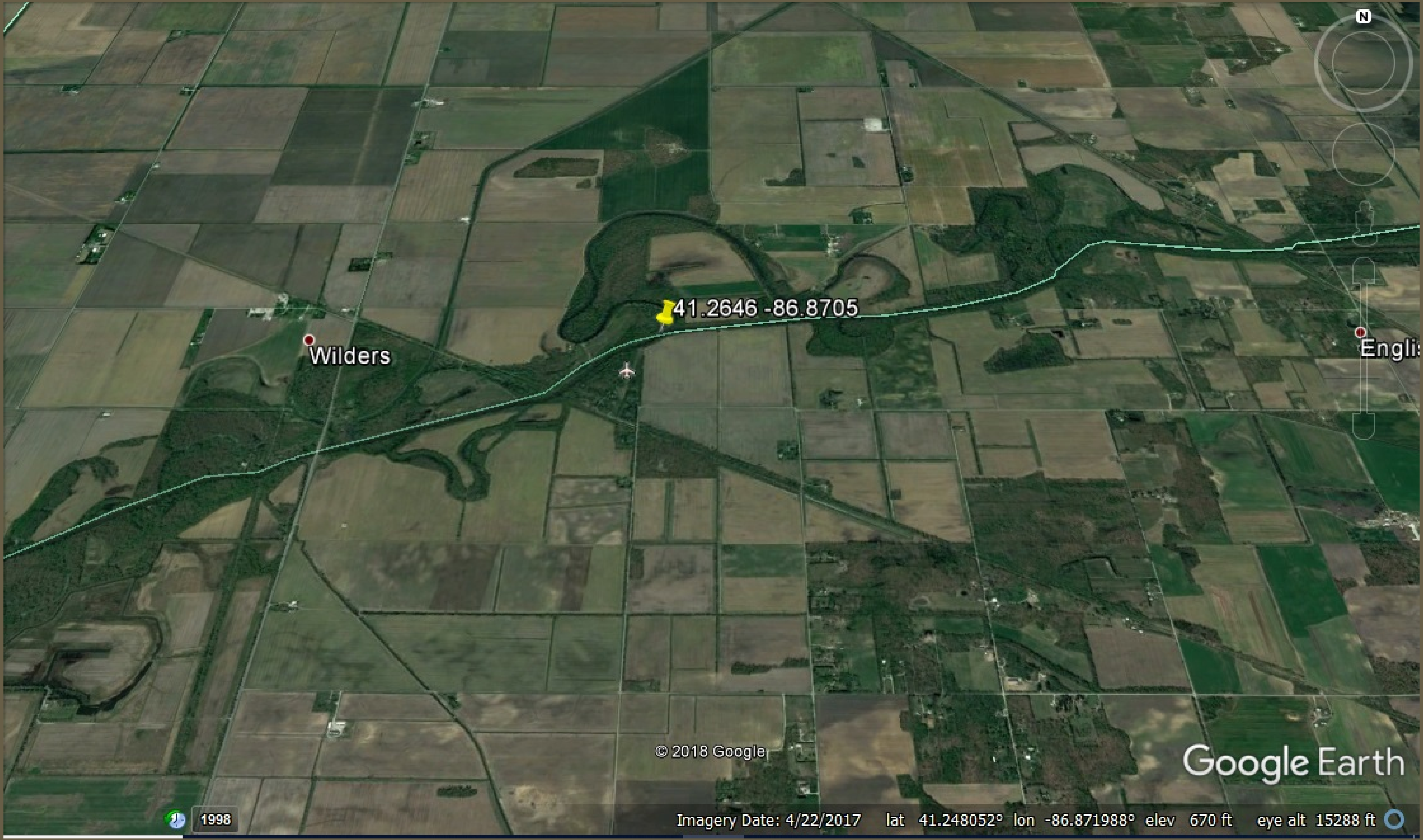

Kankakee River, Starke County, Indiana



Kankakee River, LaPorte and Starke Counties

Measured Channel Dimensions		Predicted Bankfull Channel Dimensions
Area	= 538 ft^2	= 596 ft^2
Width	= 116 ft	=132 ft
Mean d	= 4.64 ft	= 4.4 ft
Max d	= 7.0 ft	= 6.2 ft

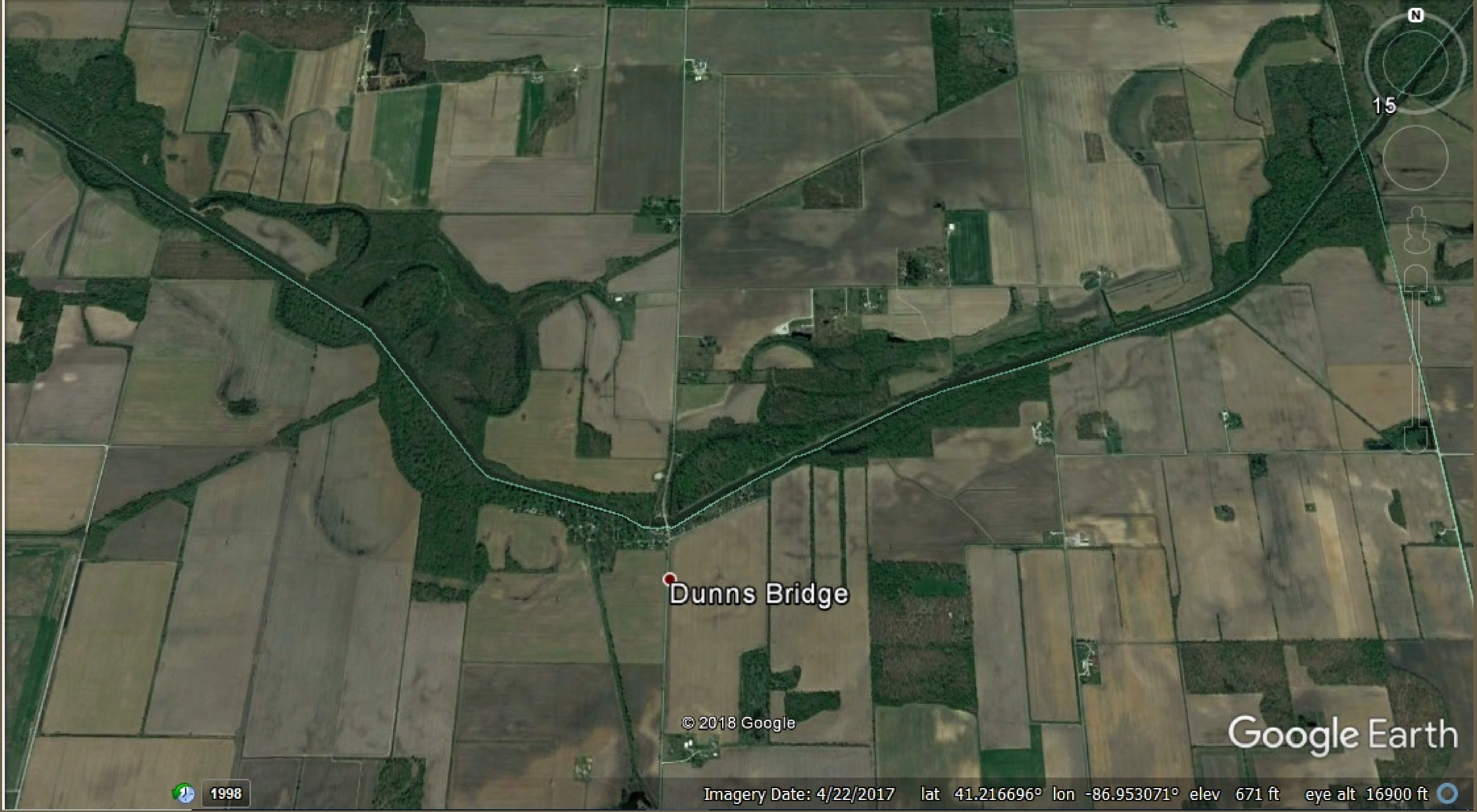
Oxbow, LaPorte County



Oxbow, LaPorte County, IN

Kankakee River, Jasper County, Indiana

Kankakee River, Porter County, Indiana



Kankakee River near Dunn’s Bridge

Kankakee River downstream from Baum’s Bridge, Porter and Jasper Counties

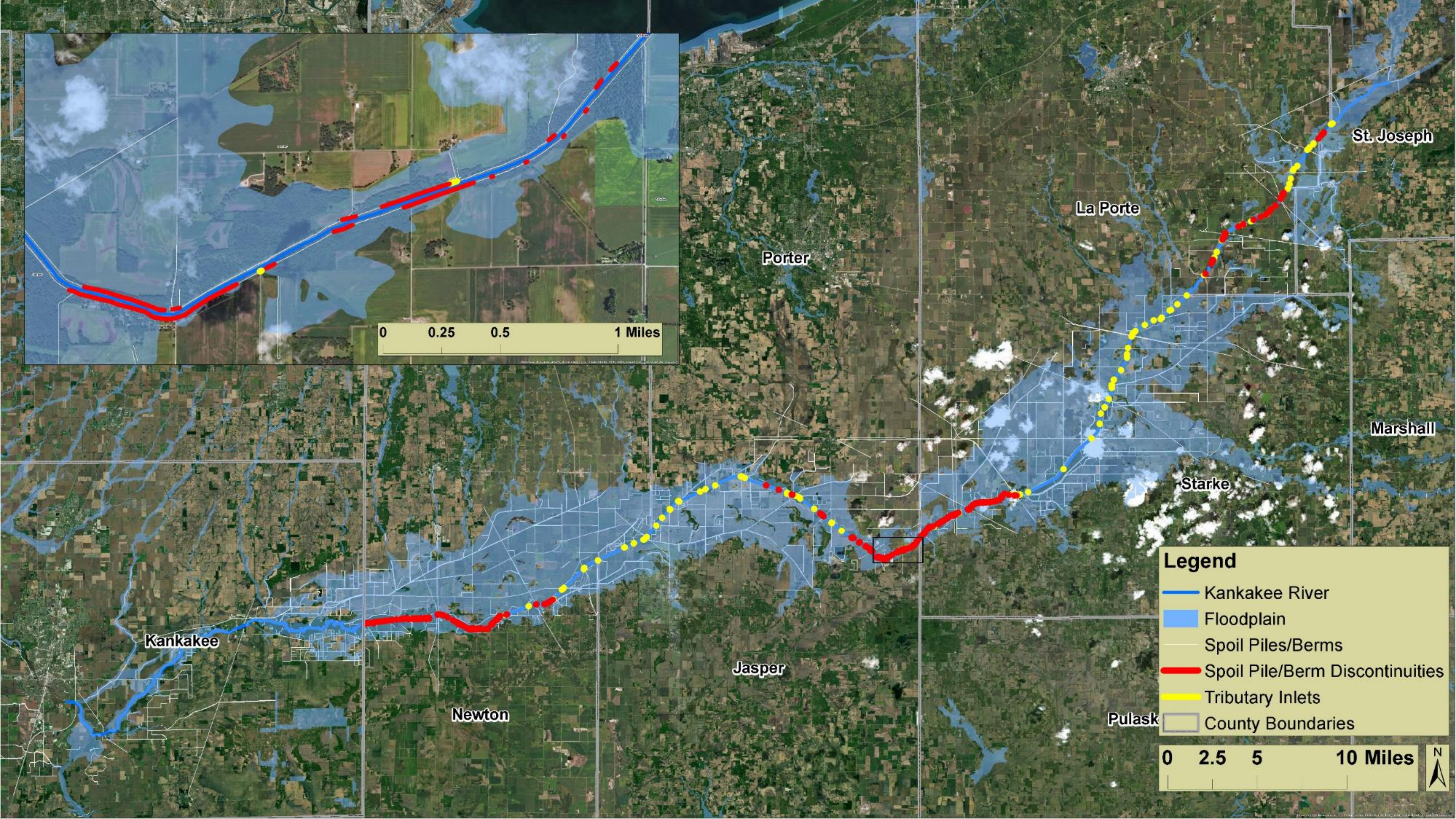
Kankakee River at I-65, Newton County

Kankakee River, Lake County, Indiana


Kankakee River, Lake County, Indiana

Kankakee River between I65 and Shelby, Newton and Lake Counties

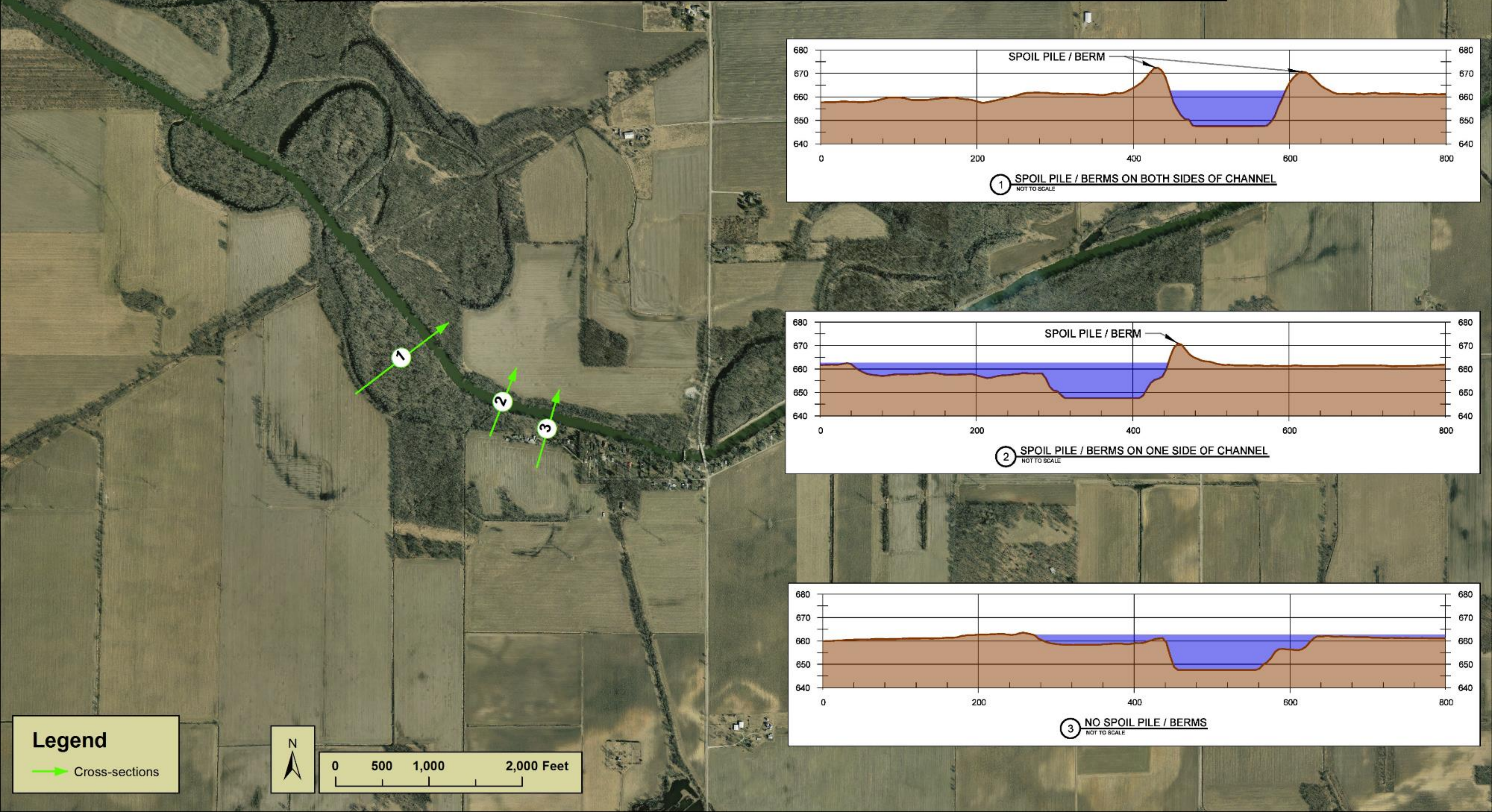
Kankakee River, Newton County, LaSalle Fish and Wildlife Area



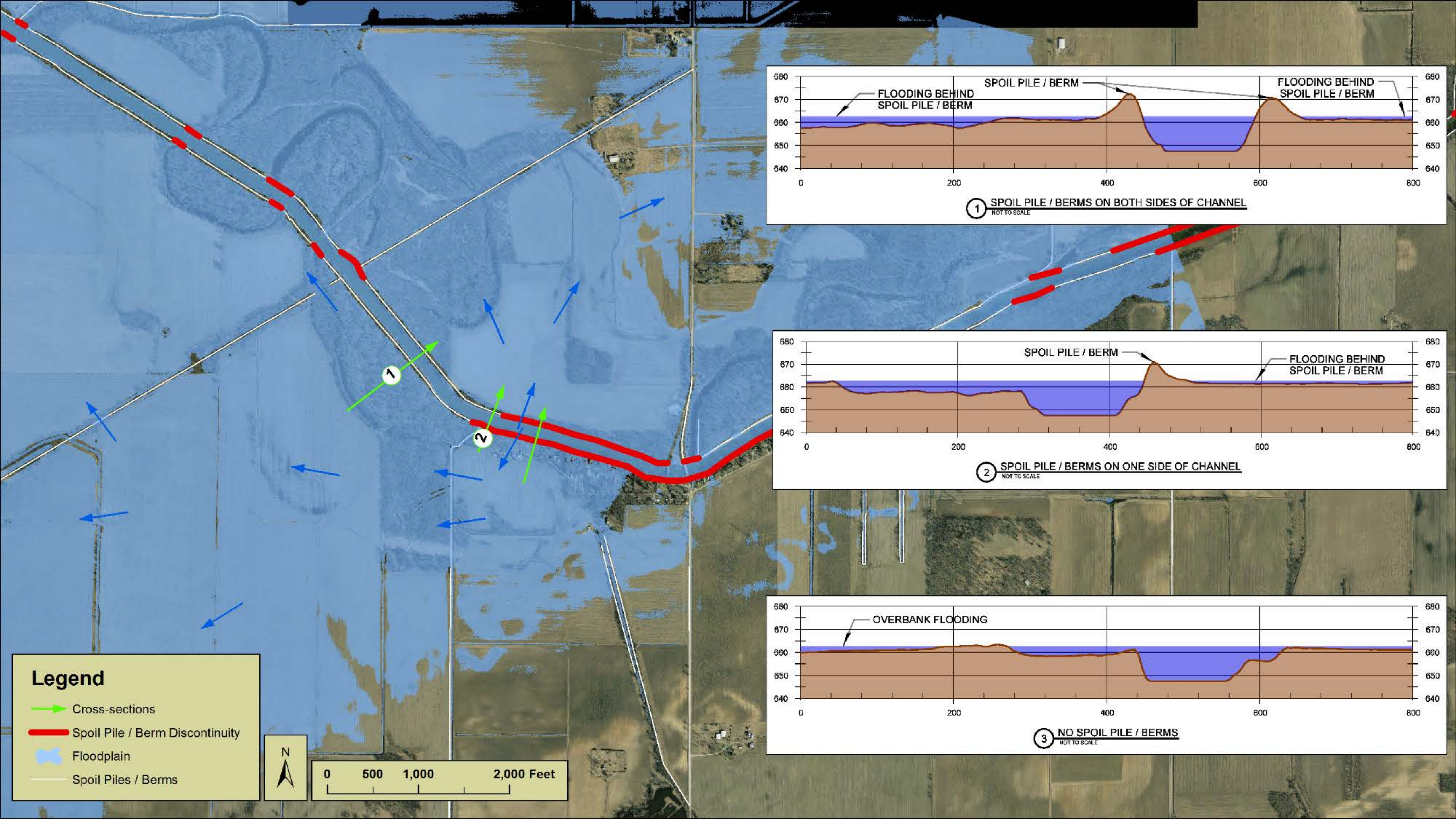
0
0.25
0.5
1 Miles
St. Joseph
La Porte
Porter
Marshall
Starke
Kankakee
Jasper
Newton
Pulask
Legend
Kankakee River
Floodplain
Spoil Piles/Berms
Spoil Pile/Berm Discontinuities
Tributary Inlets
County Boundaries
0
2.5
5
10 Miles
N

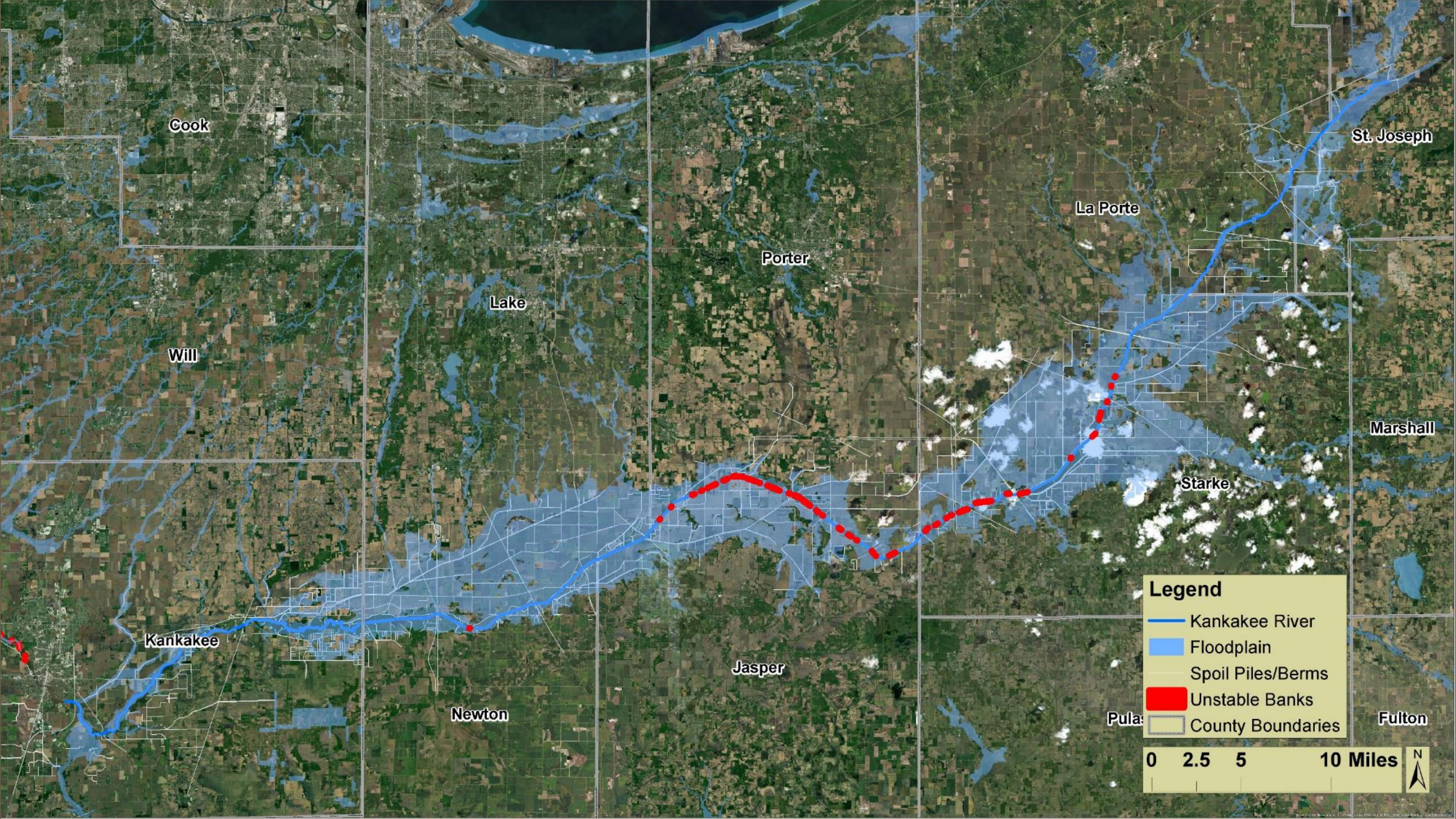
- 2D Simulation of Flooding Behind Berms

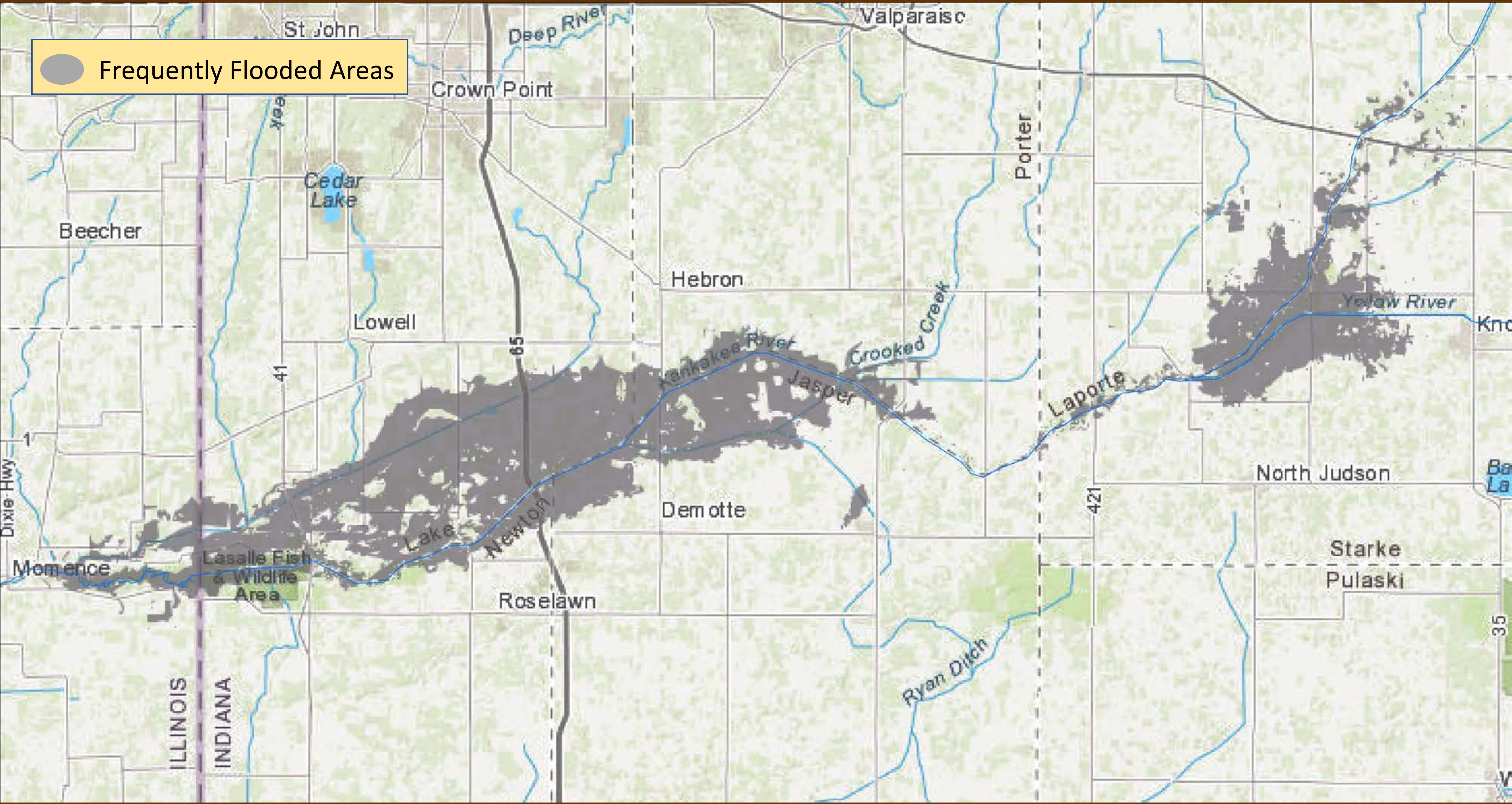
[redacted]



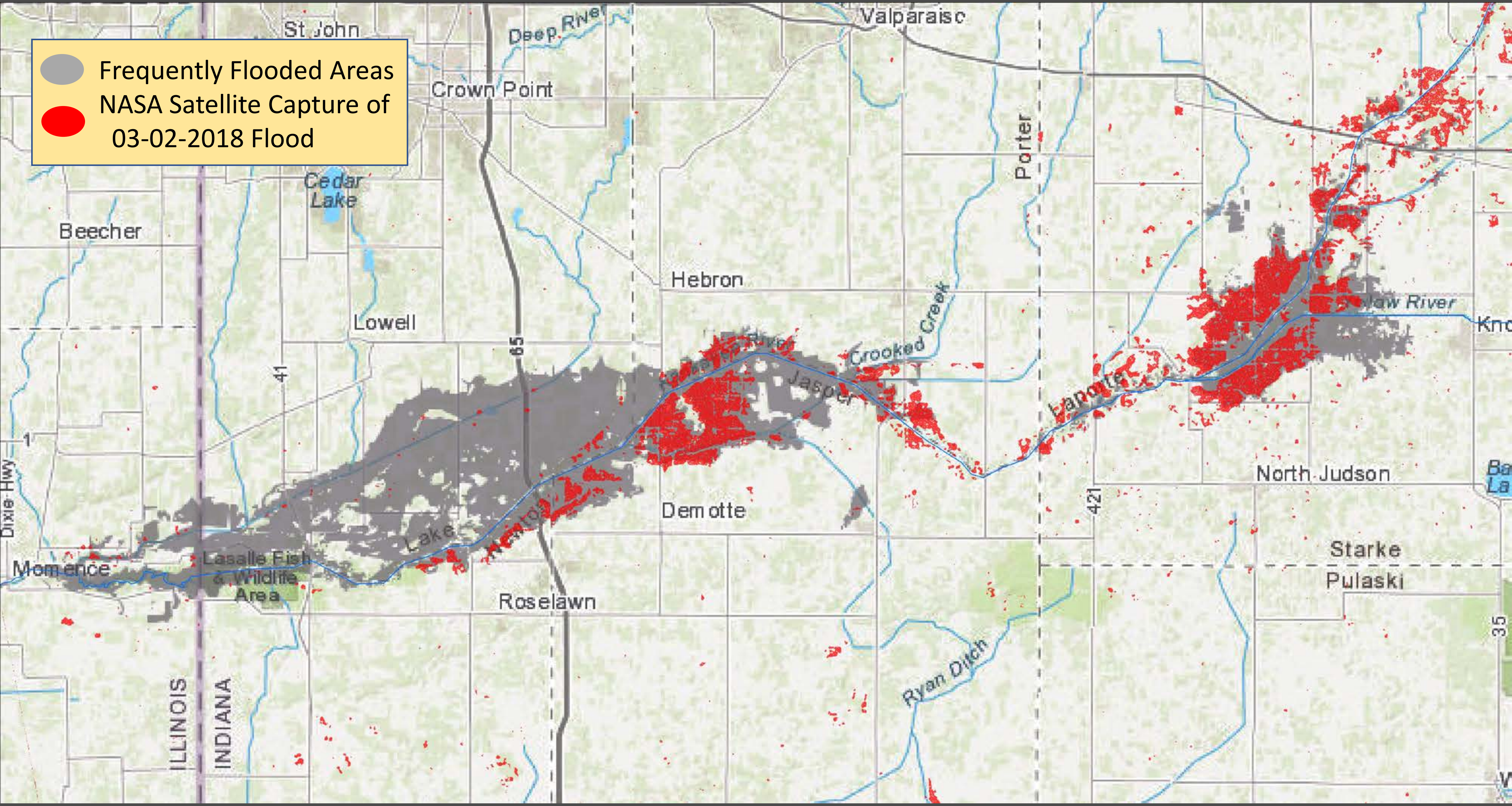
SPOIL PILE / BERM
680
670
660
650
640
0
200
400
600
800
1 SPOIL PILE / BERMS ON BOTH SIDES OF CHANNEL
NOT TO SCALE
SPOIL PILE / BERM
2 SPOIL PILE / BERMS ON ONE SIDE OF CHANNEL
NOT TO SCALE
3 NO SPOIL PILE / BERMS
NOT TO SCALE
1
2
3
Legend
Cross-sections
N
0 500 1,000 2,000 Feet


FLOODING BEHIND SPOIL PILE / BERM
SPOIL PILE / BERM
FLOODING BEHIND SPOIL PILE / BERM
680
670
660
650
640
0
200
400
600
800
1 SPOIL PILE / BERMS ON BOTH SIDES OF CHANNEL
NOT TO SCALE
SPOIL PILE / BERM
FLOODING BEHIND SPOIL PILE / BERM
2 SPOIL PILE / BERMS ON ONE SIDE OF CHANNEL
NOT TO SCALE
OVERBANK FLOODING
3 NO SPOIL PILE / BERMS
NOT TO SCALE
Legend
Cross-sections
Spoil Pile / Berm Discontinuity
Floodplain
Spoil Piles / Berms
N
0
500
1,000
2,000 Feet

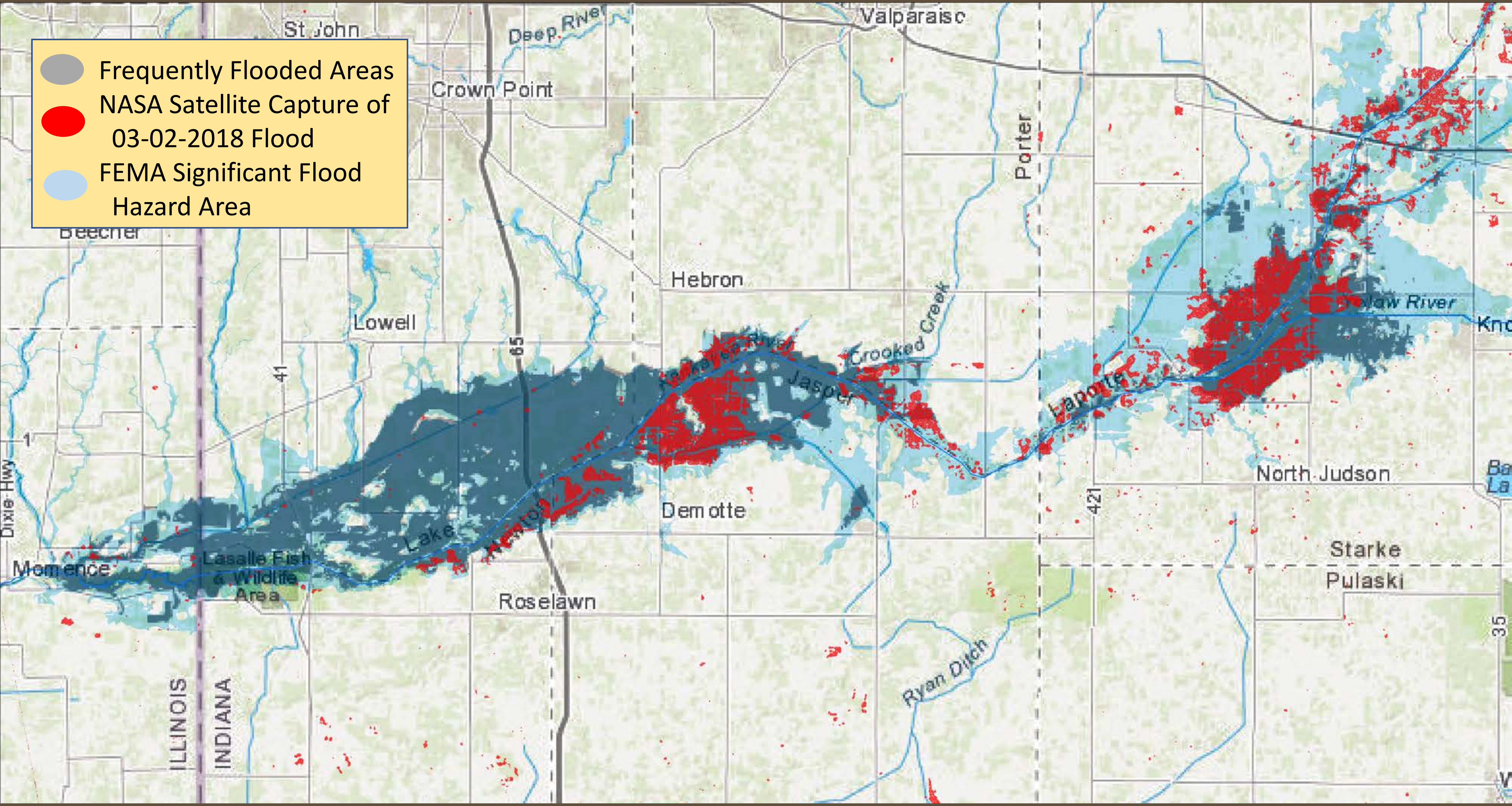

Cook
St. Joseph
La Porte
Porter
Lake
Will
Marshall
Starke
Kankakee
Jasper
Newton
Pulas
Fulton
Legend
Kankakee River
Floodplain
Spoil Piles/Berms
Unstable Banks
County Boundaries
0 2.5 5 10 Miles
N



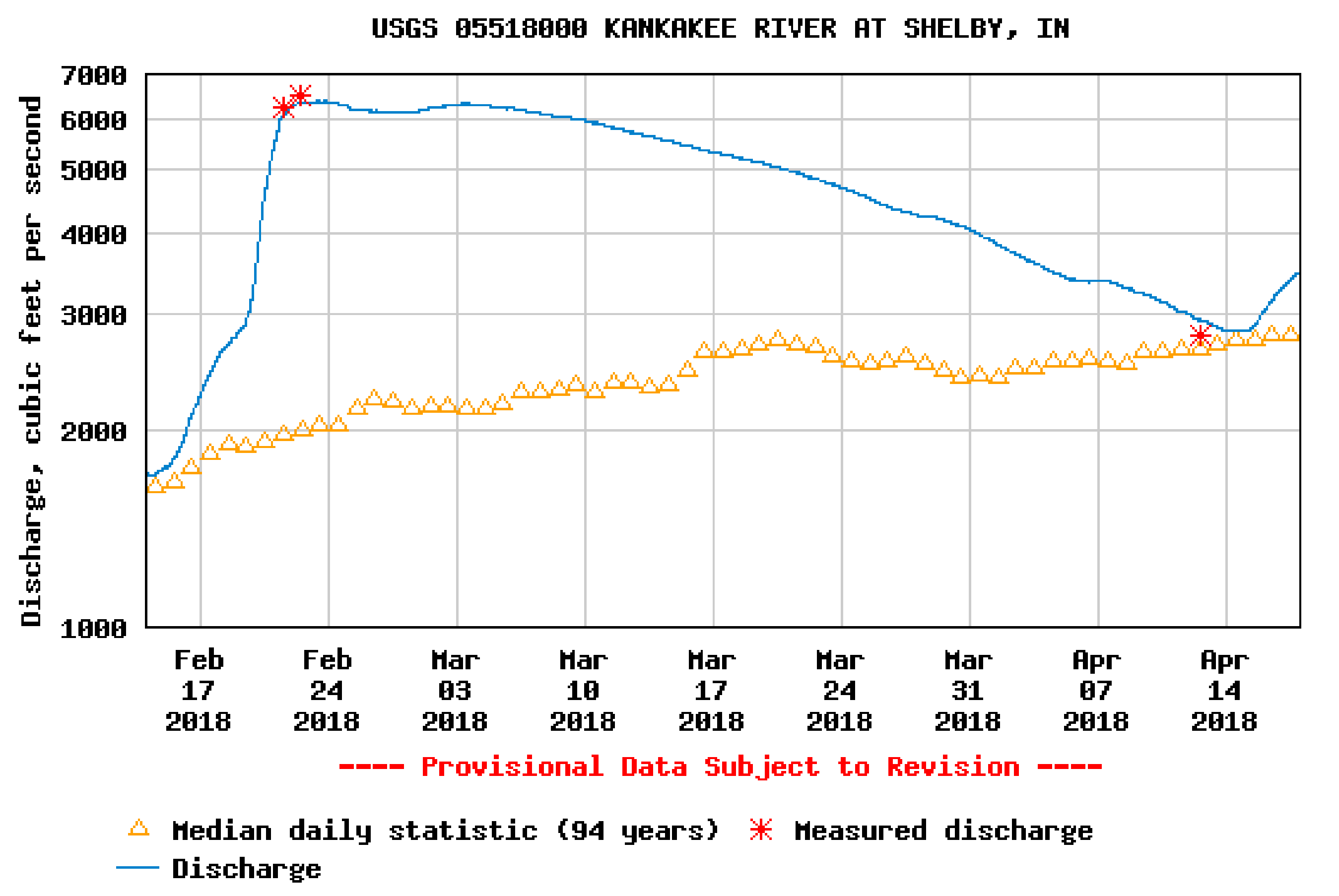
Frequently Flooded Areas
St John
Deep River
Valparaiso
Crown Point
Cedar Lake
Beecher
Porter
Hebron
Lowell
Kankakee River
Crooked Creek
Jasper
Laporte
Yellow River
65
41
421
Dixie Hwy
North Judson
Demotte
Starke
Pulaski
Lake
Newton
Momence
Lasalle Fish & Wildlife Area
Roselawn
Ryan Ditch
ILLINOIS
INDIANA

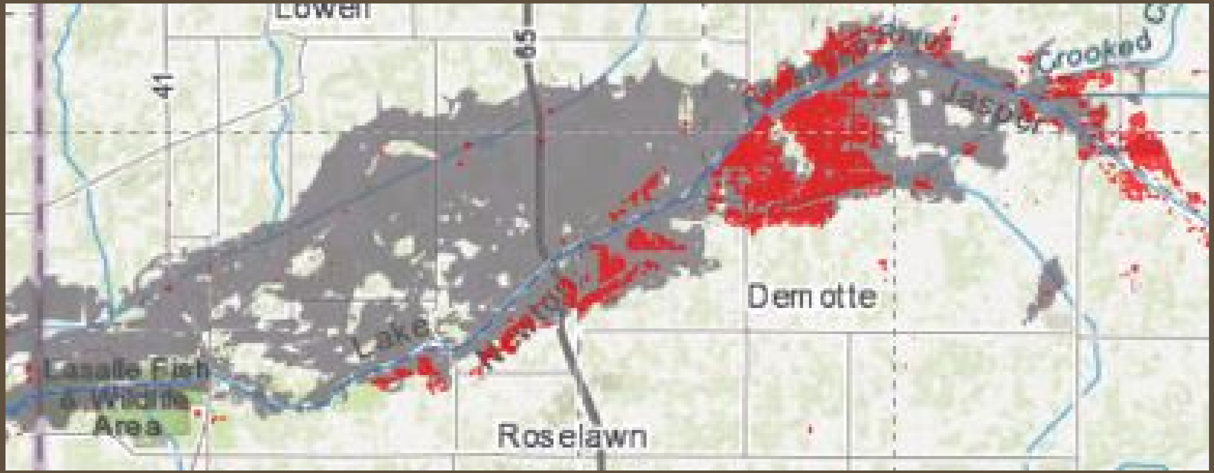


Frequently Flooded Areas
NASA Satellite Capture of
03-02-2018 Flood
St John
Deep River
Valparaiso
Crown Point
Cedar Lake
Beecher
Hebron
Porter
Lowell
Crooked Creek
Jasper
Laporte
Knox
North Judson
Demotte
Lake
Newton
Momence
Lasalle Fish & Wildlife Area
Roselawn
Starke
Pulaski
Ryan Ditch
ILLINOIS
INDIANA
Dixie Hwy
65
41
421
35
1



Frequently Flooded Areas
NASA Satellite Capture of 03-02-2018 Flood
FEMA Significant Flood Hazard Area
St John
Deep River
Crown Point
Porter
Hebron
Crooked Creek
Lowell
65
41
Jasper
Laporte
North Judson
Demotte
421
Starke
Pulaski
Momence
Lasalle Fish & Wildlife Area
Lake
Newton
Roselawn
Ryan Ditch
Dixie Hwy
ILLINOIS
INDIANA
35





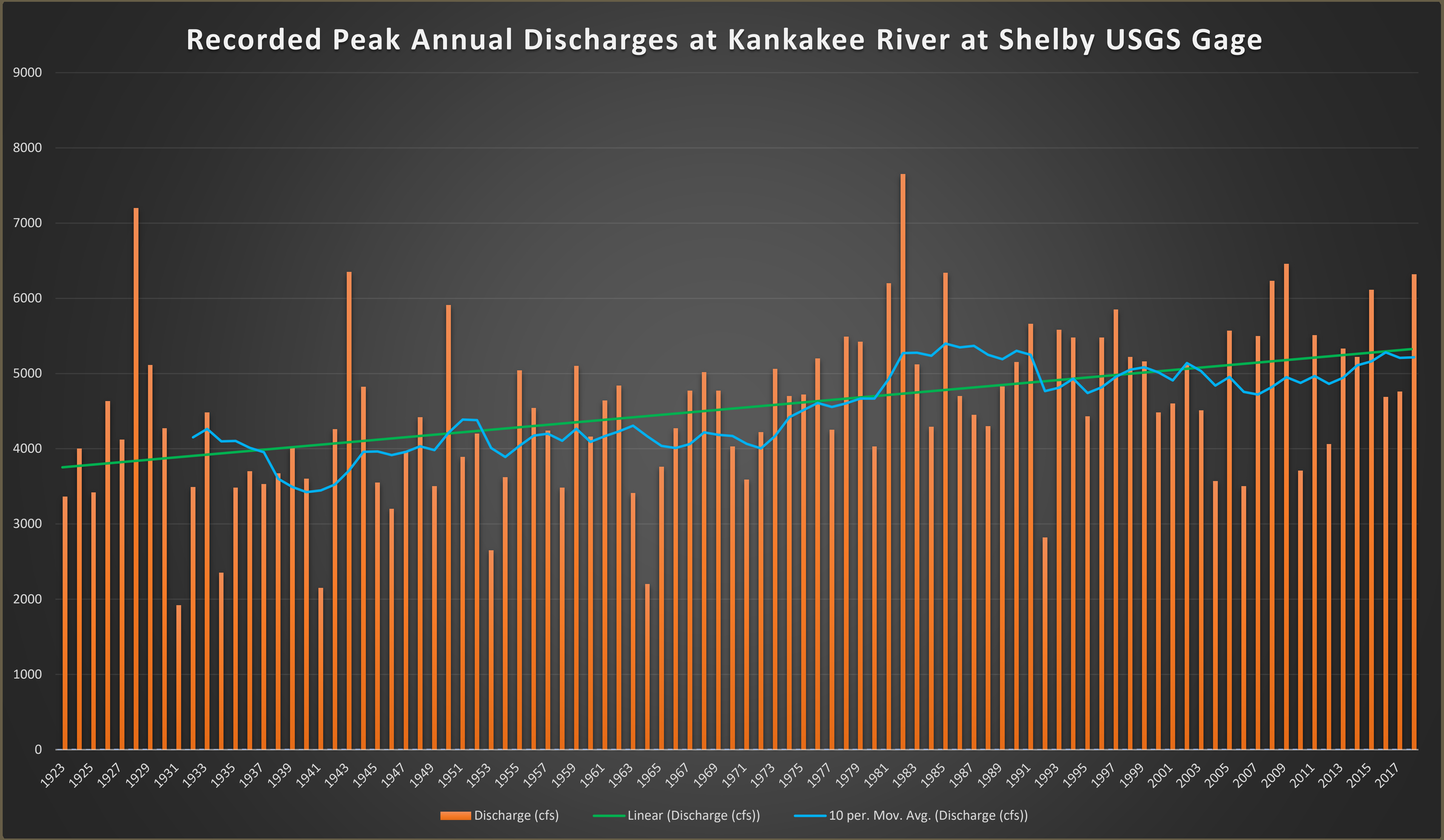
Hydrograph Volume ≈ 555,000 ac-ft.

Extra Volume to be Stored

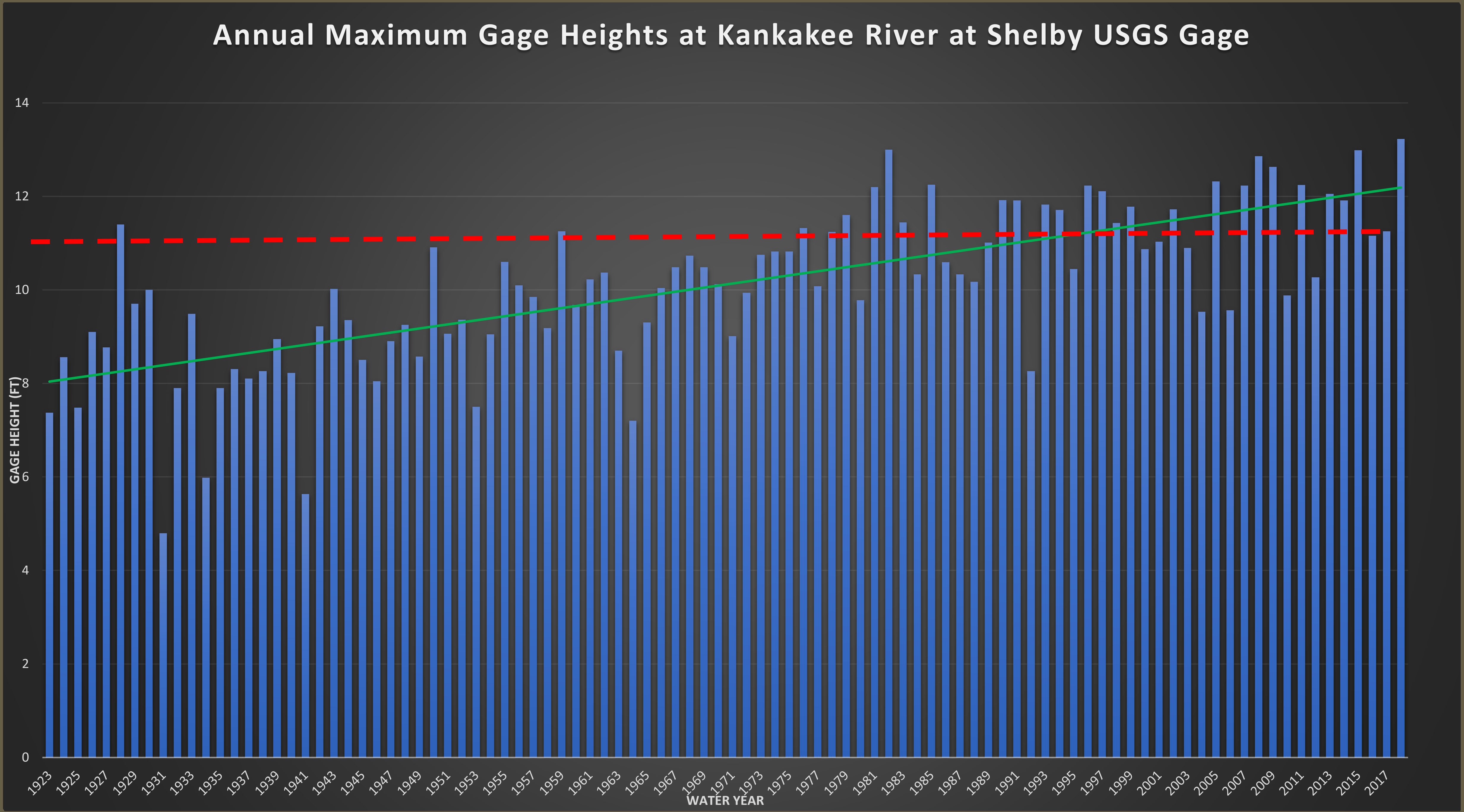
≈ 220,000 ac-ft.

(The size of the entire Starke County land area flooded by one foot! or about 28,000 acres, stacked 8 feet high with water)

*** Existing Flood Storage has Kept Flood Heights Lower!**

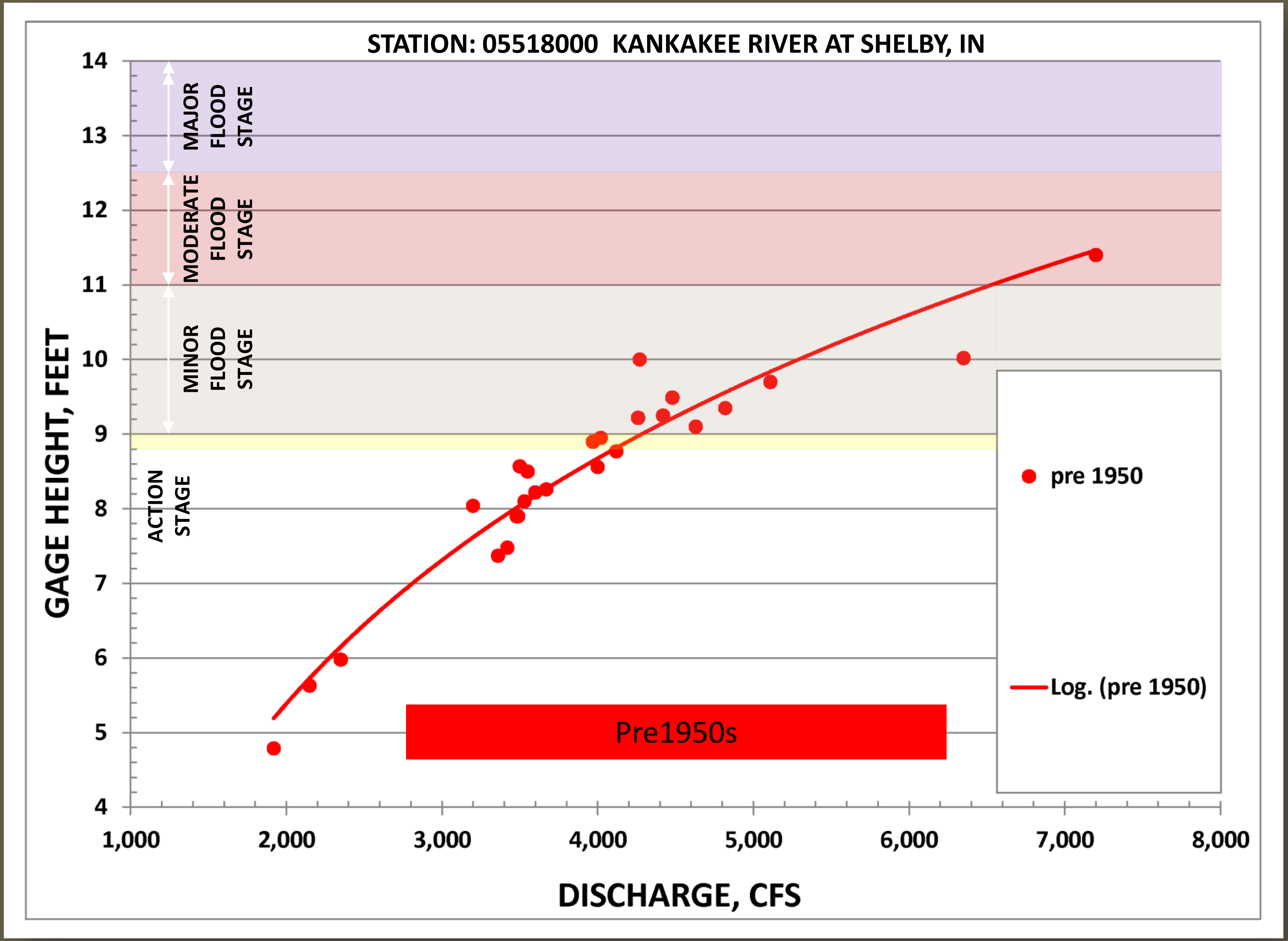


Recorded Peak Annual Discharges at Kankakee River at Shelby USGS Gage
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1923
1925
1927
1929
1931
1933
1935
1937
1939
1941
1943
1945
1947
1949
1951
1953
1955
1957
1959
1961
1963
1965
1967
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
2015
2017
Discharge (cfs)
Linear (Discharge (cfs))
10 per. Mov. Avg. (Discharge (cfs))

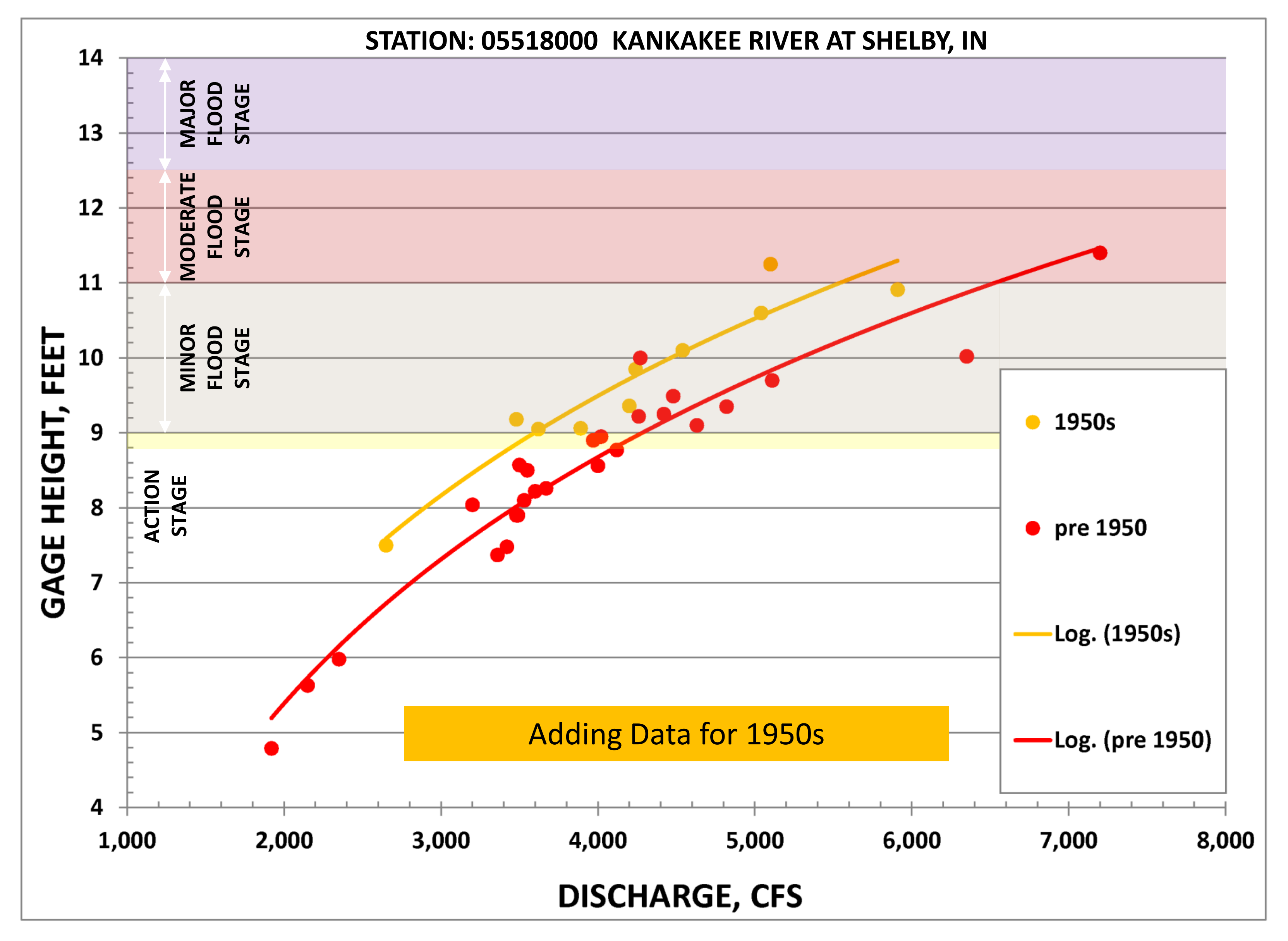


Annual Maximum Gage Heights at Kankakee River at Shelby USGS Gage
GAGE HEIGHT (FT)
0
2
4
6
8
10
12
14
WATER YEAR
1923
1925
1927
1929
1931
1933
1935
1937
1939
1941
1943
1945
1947
1949
1951
1953
1955
1957
1959
1961
1963
1965
1967
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
2015
2017

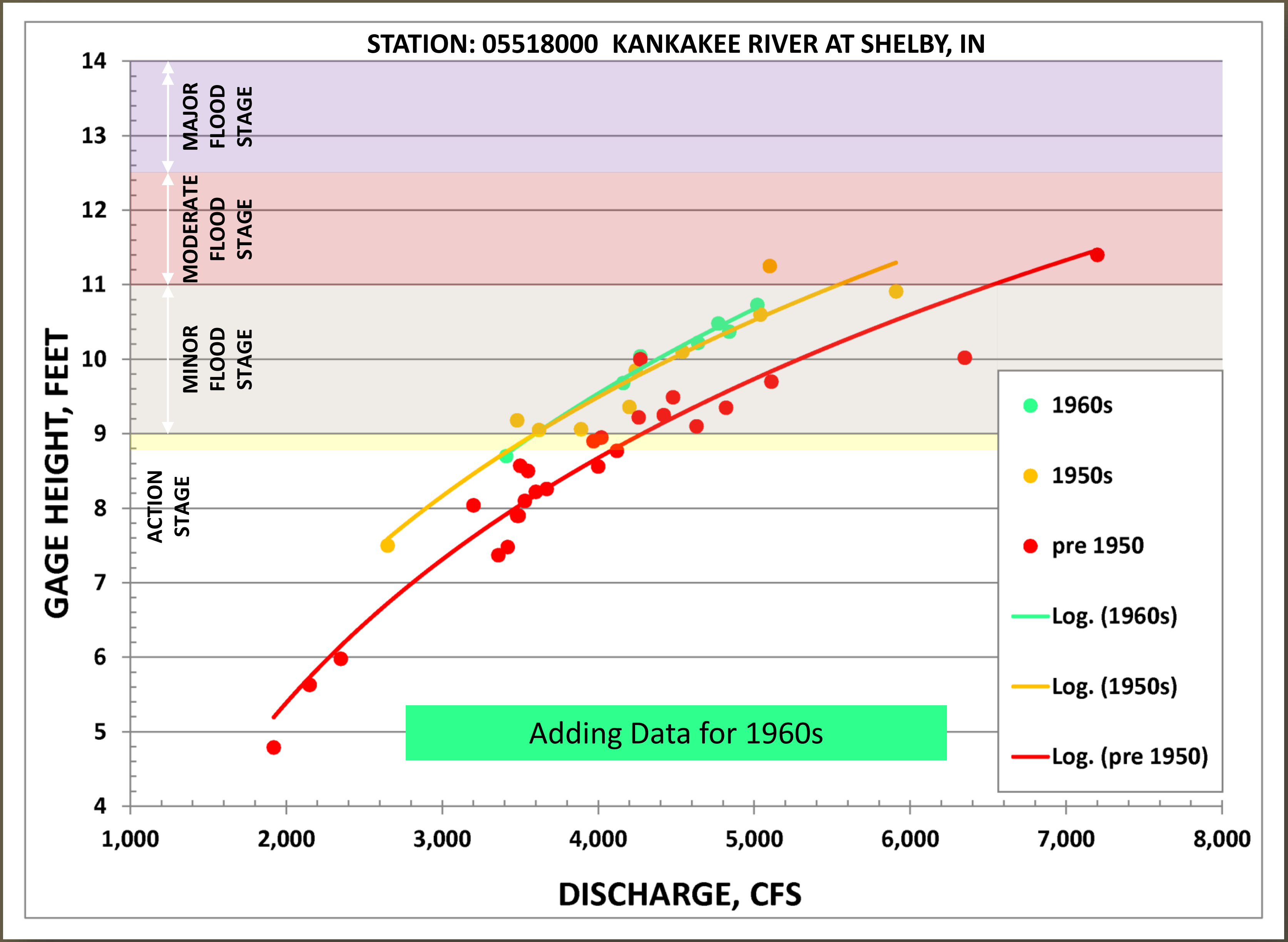
Gage Height Increasing Trends at the Kankakee at Shelby USGS Gage



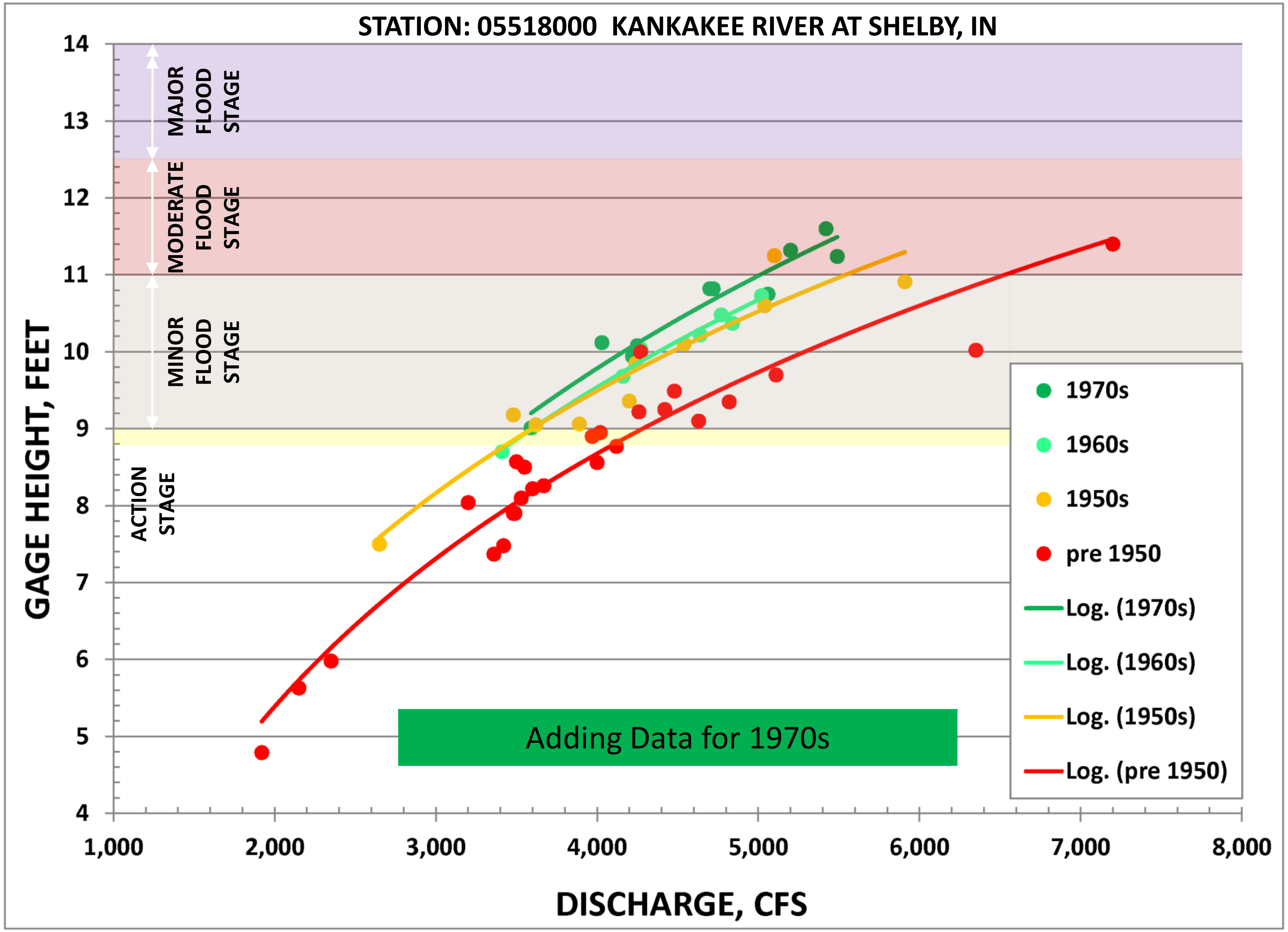
Gage Height Increasing Trends at Kankakee at the Shelby USGS Gage (cont'd.)



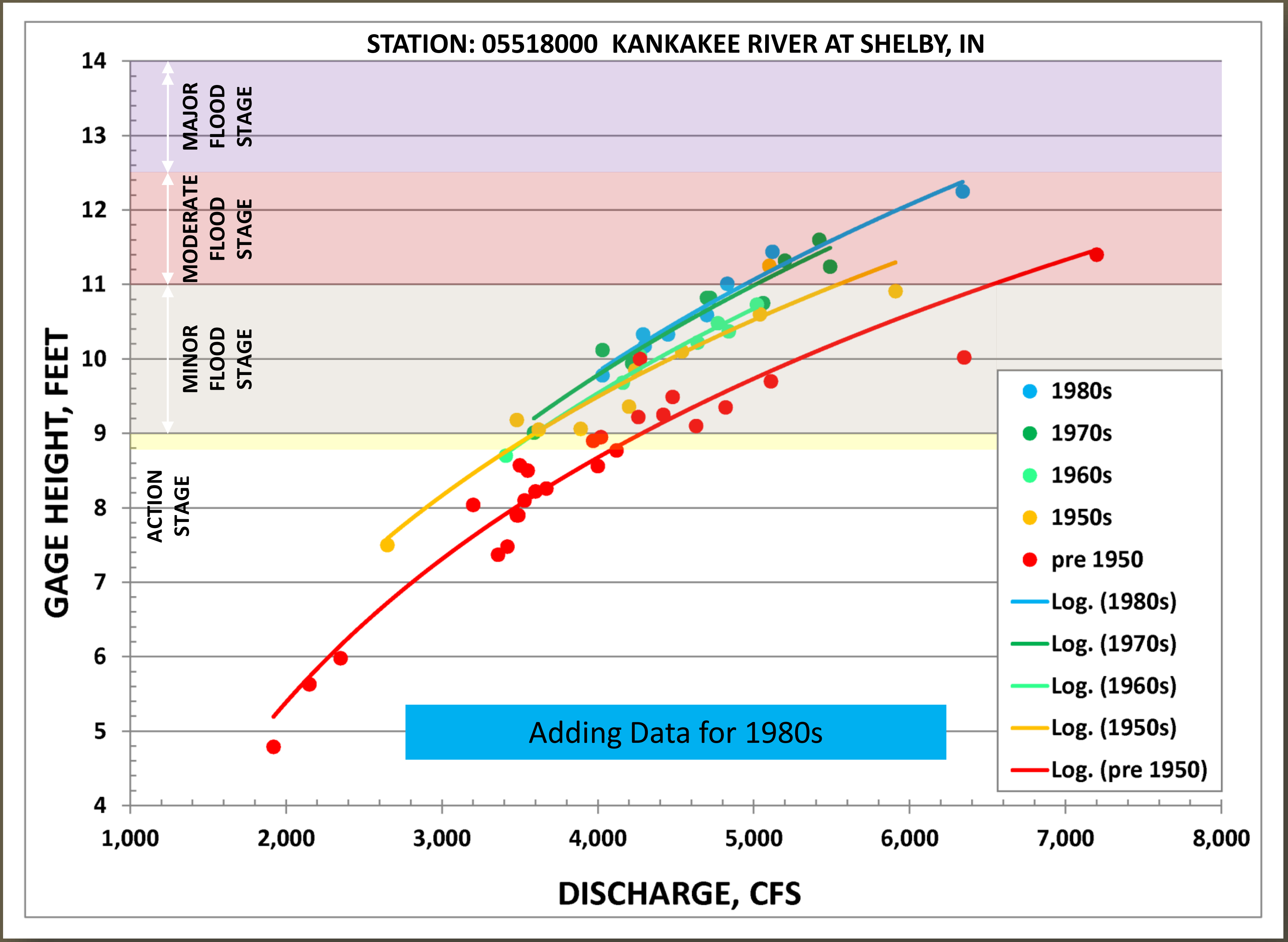
Gage Height Increasing Trends at Kankakee at the Shelby USGS Gage (cont'd.)



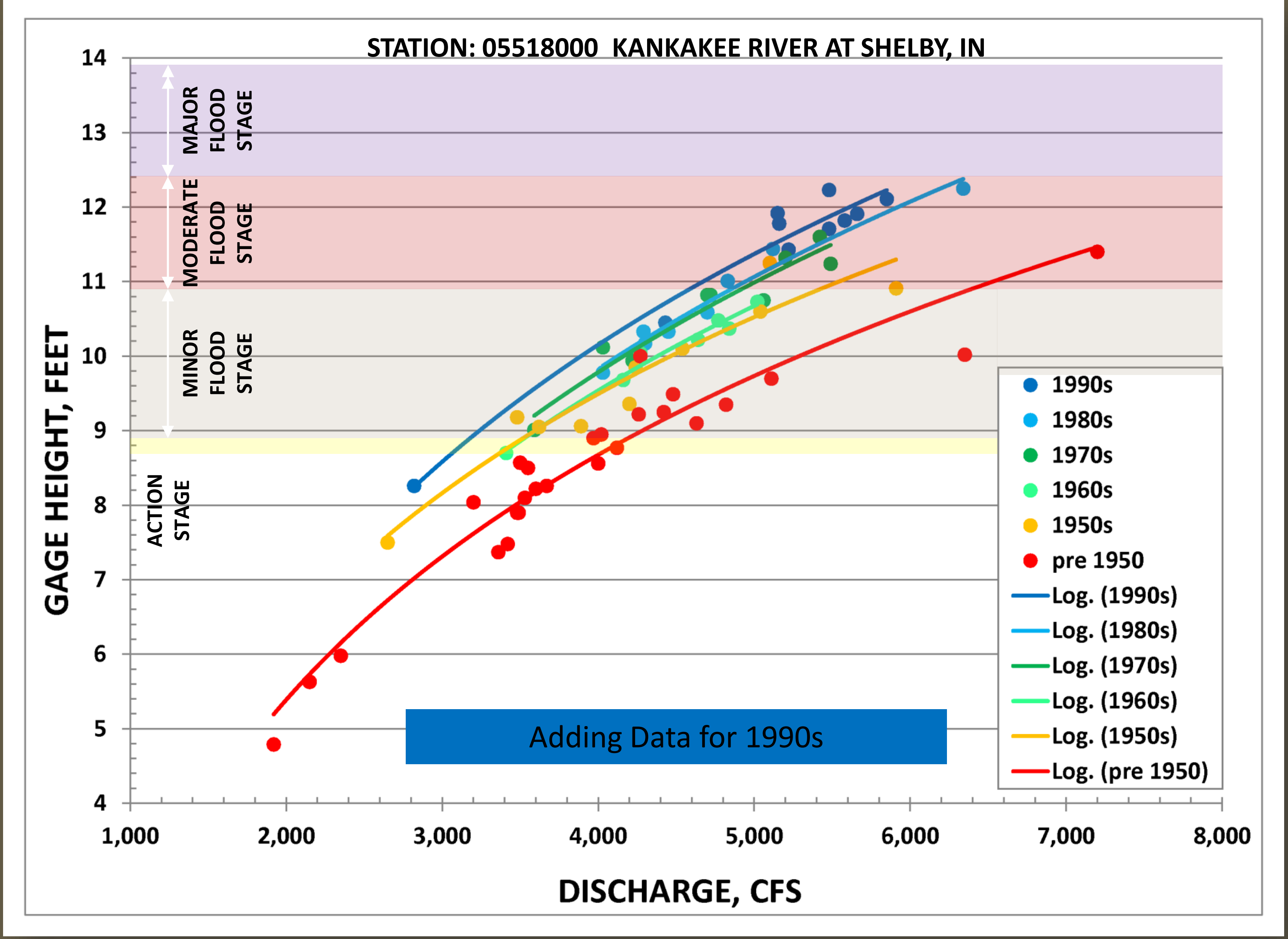
Gage Height Increasing Trends at Kankakee at the Shelby USGS Gage (cont'd.)



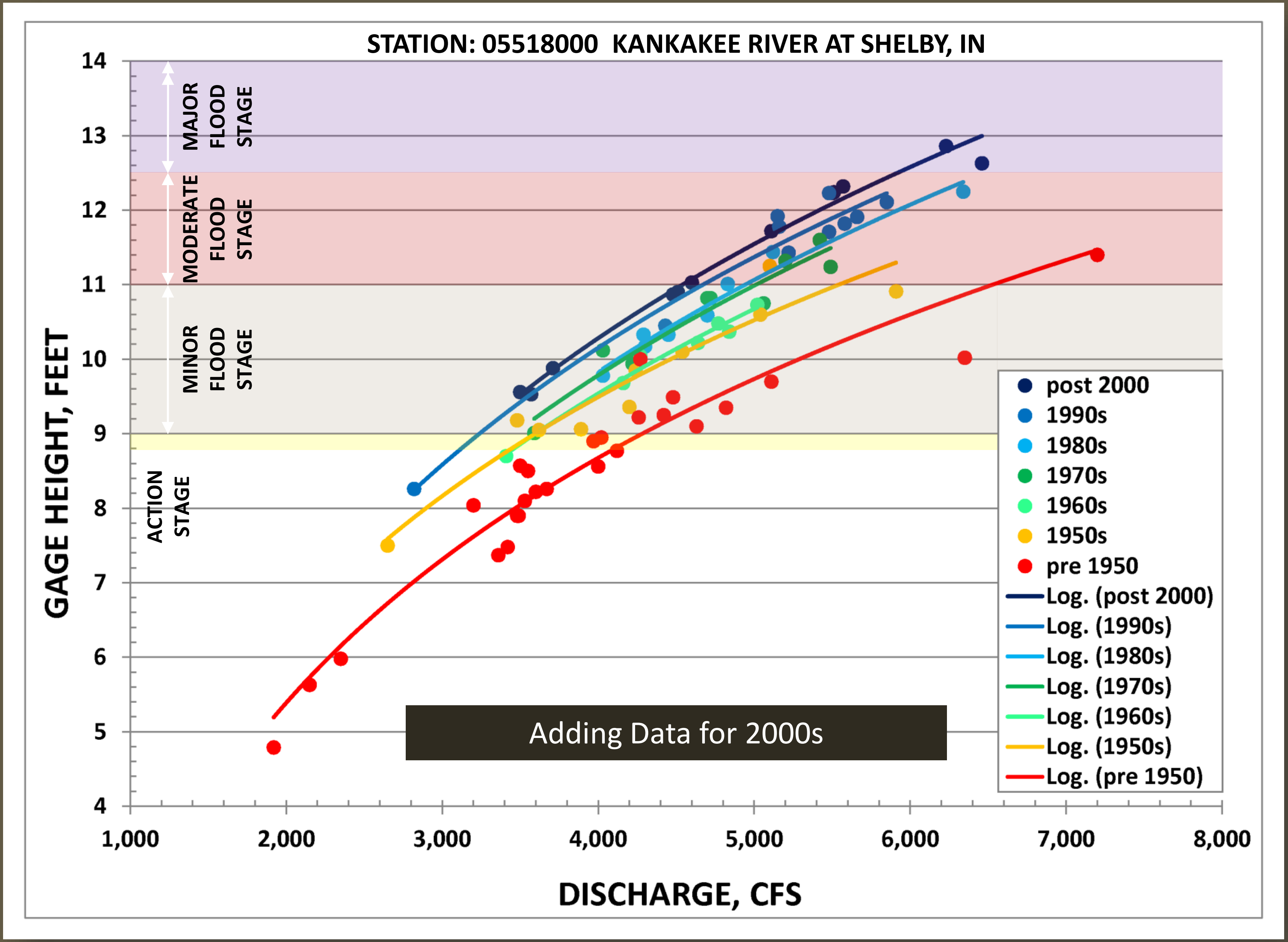
Gage Height Increasing Trends at Kankakee at the Shelby USGS Gage (cont'd.)



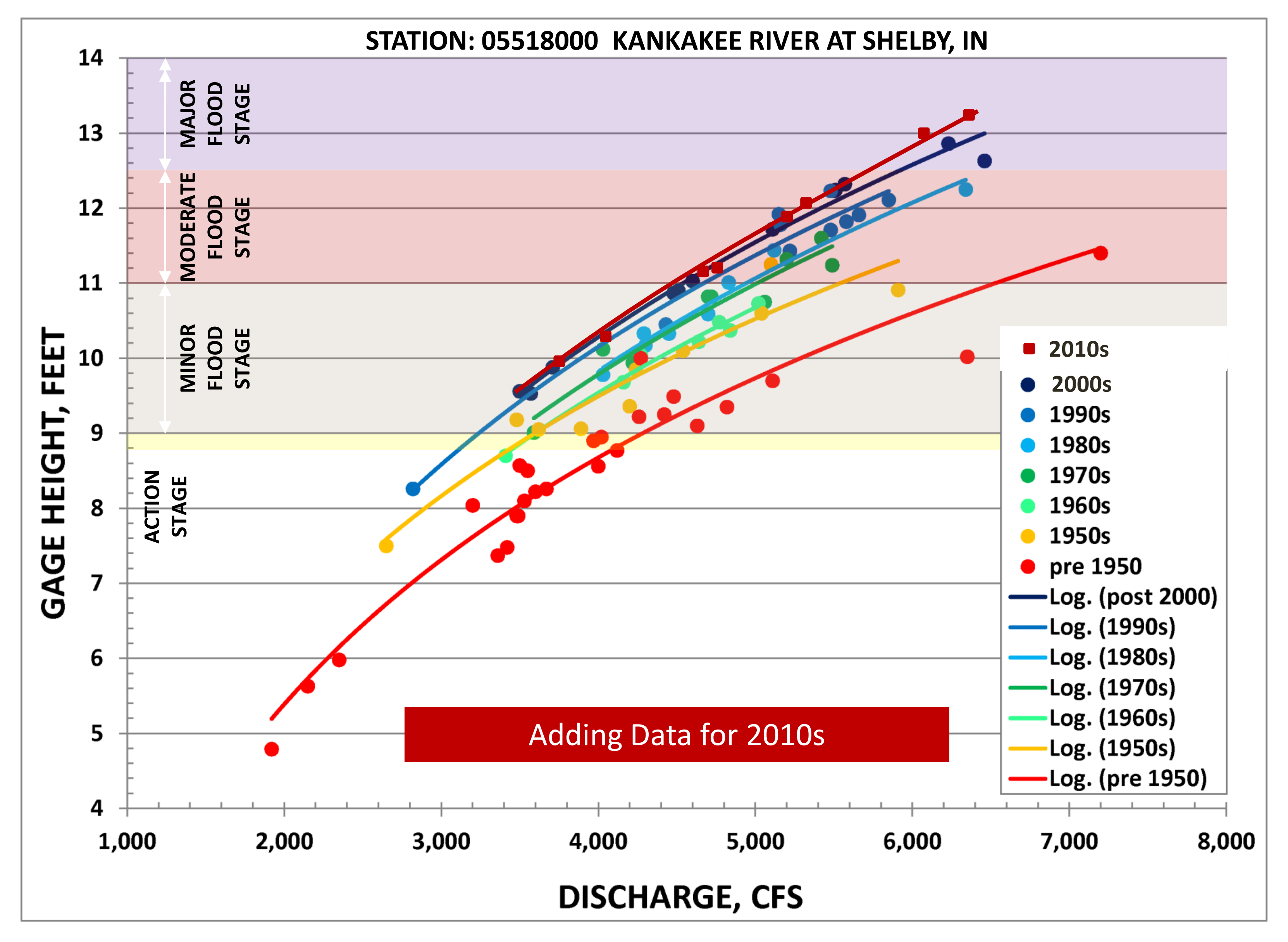
Gage Height Increasing Trends at Kankakee at the Shelby USGS Gage (cont'd.)



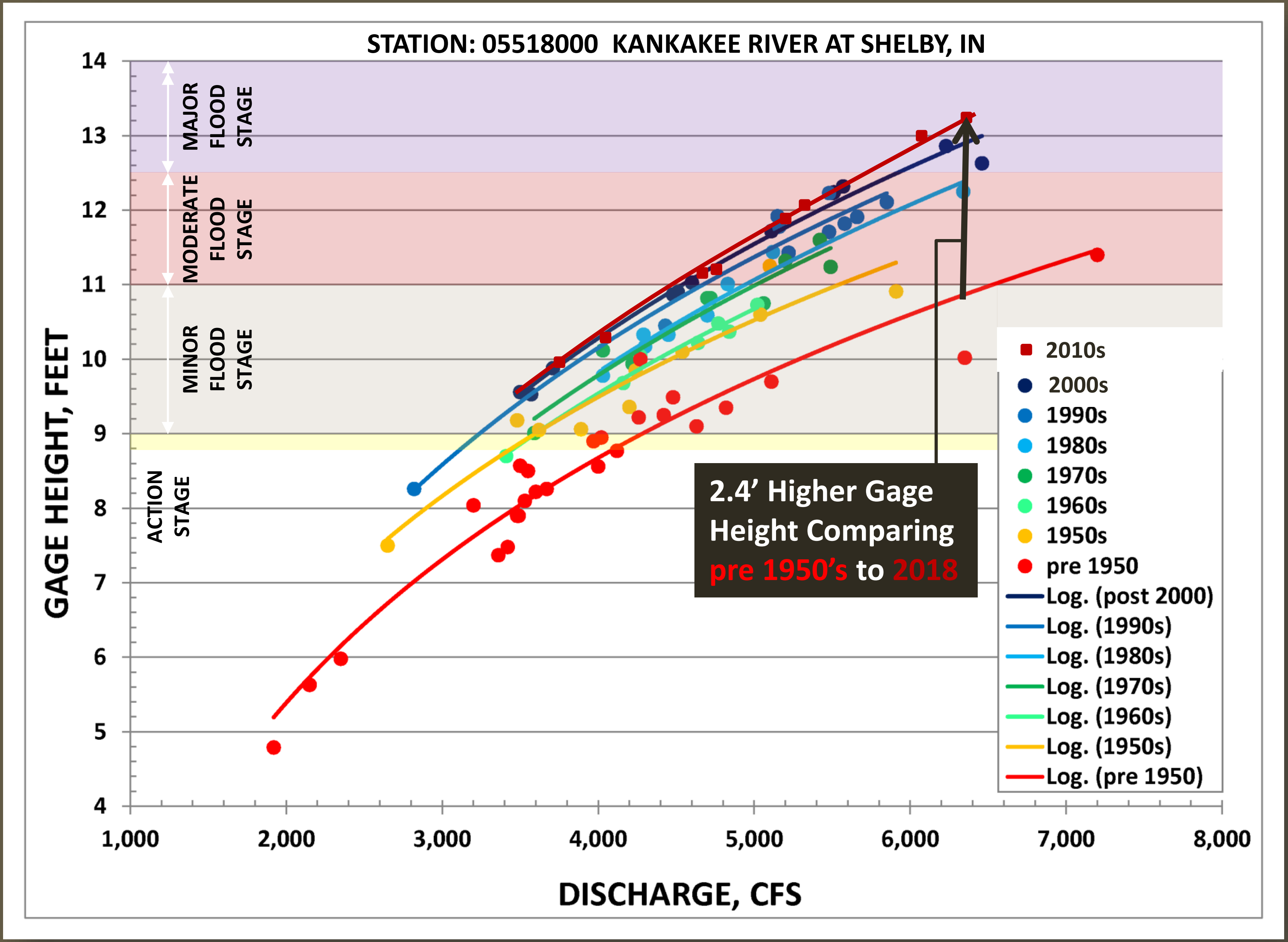
Gage Height Increasing Trends at Kankakee at the Shelby USGS Gage (cont'd.)



Gage Height Increasing Trends at Kankakee at the Shelby USGS Gage (cont'd.)



Implications of Gage Height Increasing Trends

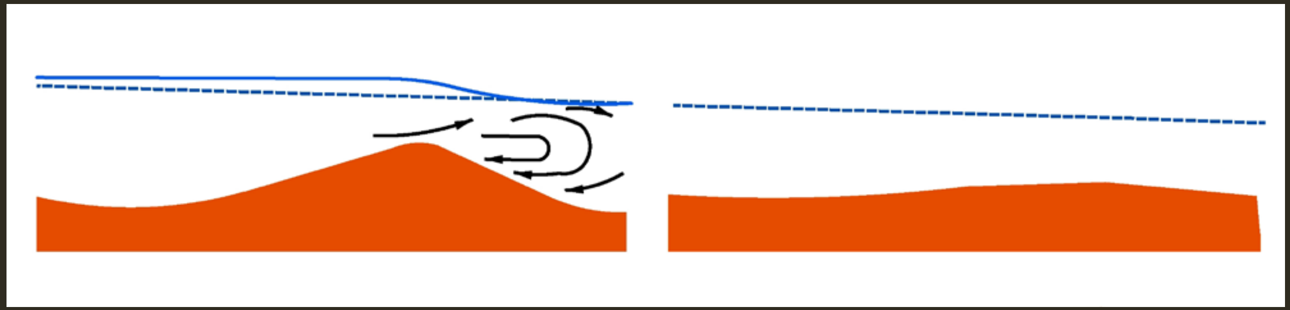


Why Are Gage Heights Increasing for the Same Flow Value During Large Floods ?!

1. Loss of Floodplain Storage Due to Berms on Main Stem and Laterals

2. Accumulation of Sediment and Logs/trash Behind Railroad Bridge During Floods

3. Moving Sediment Wedges During Flood Events

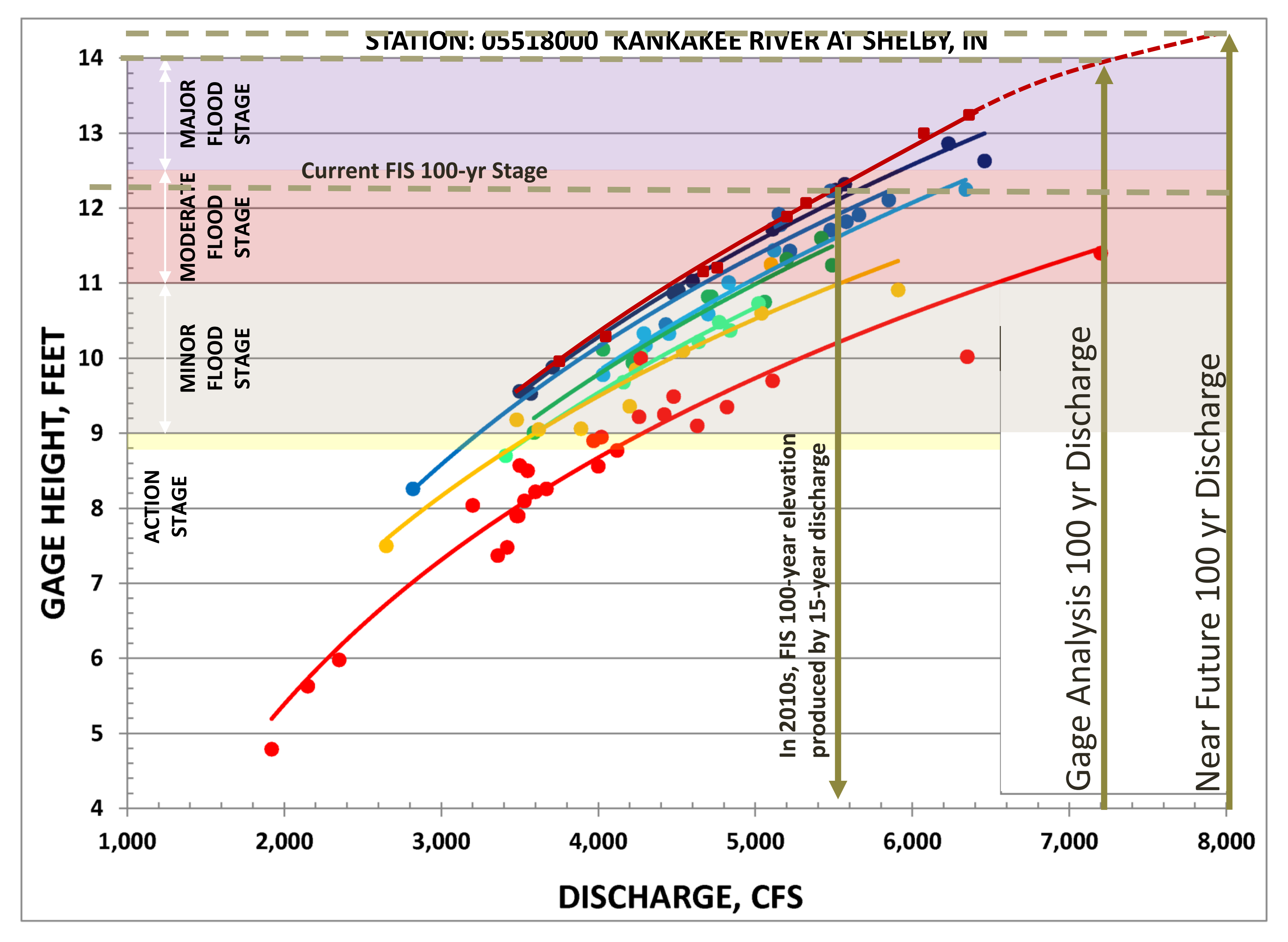


Temporary Sediment Wedge During Flood

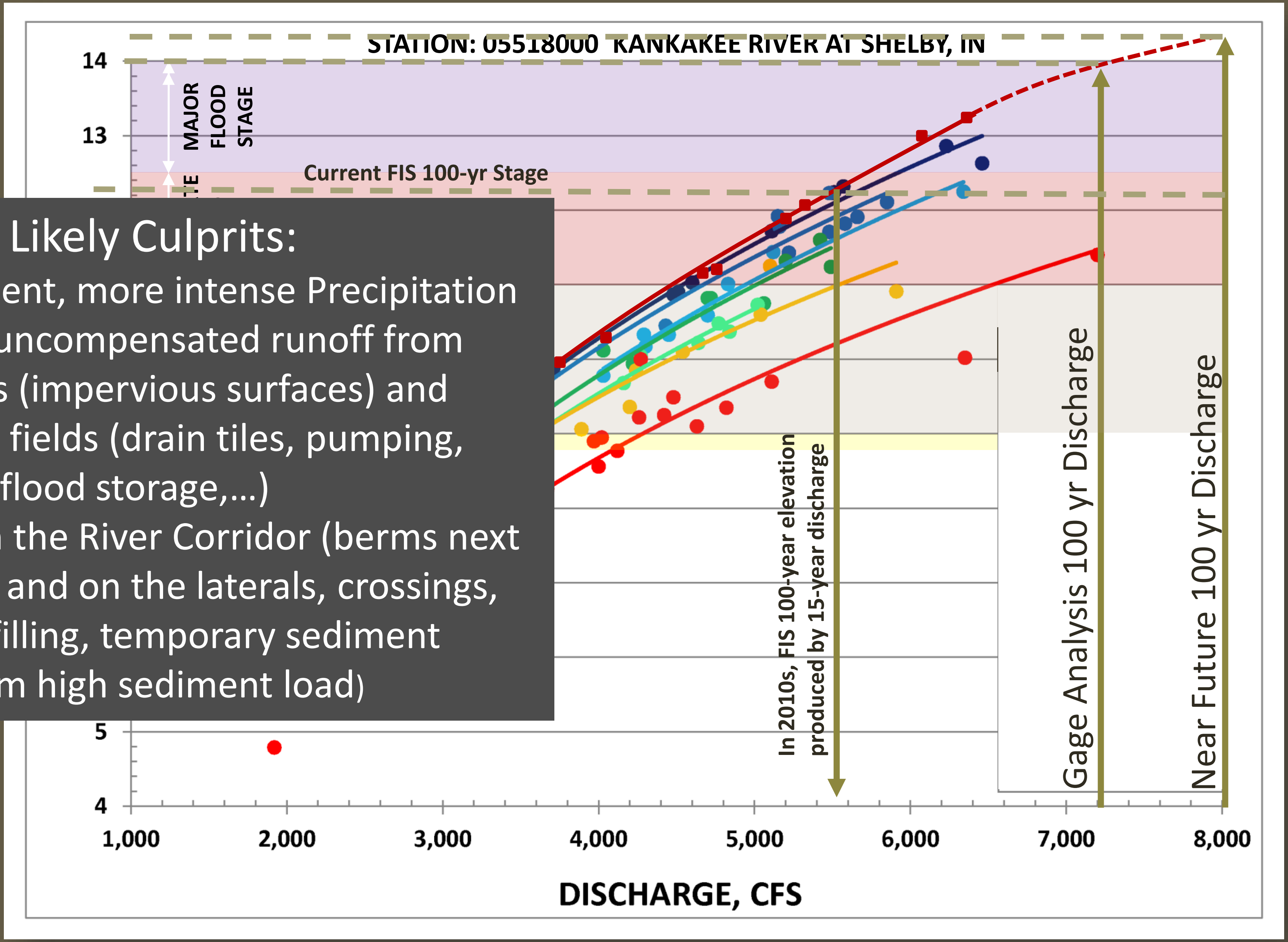
Sediment Wedge Leveled After Flood

❖ This observation is location-specific. Similar analysis at Dunns Bridge and Davis Gages did not show the same trend

Implications of Gage Height Increasing Trends (cont'd.)

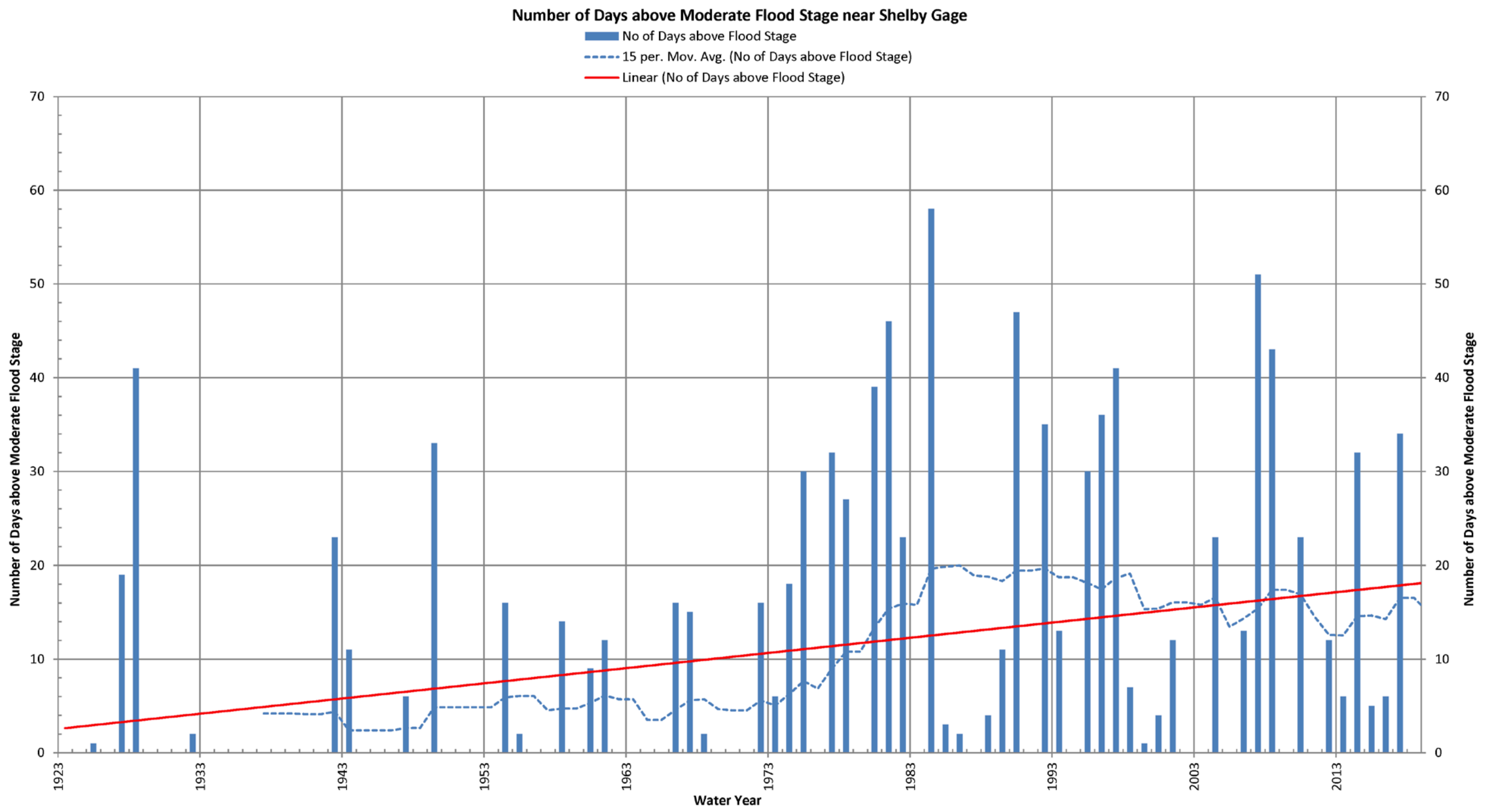


Implications of Gage Height Increasing Trends (cont'd.)



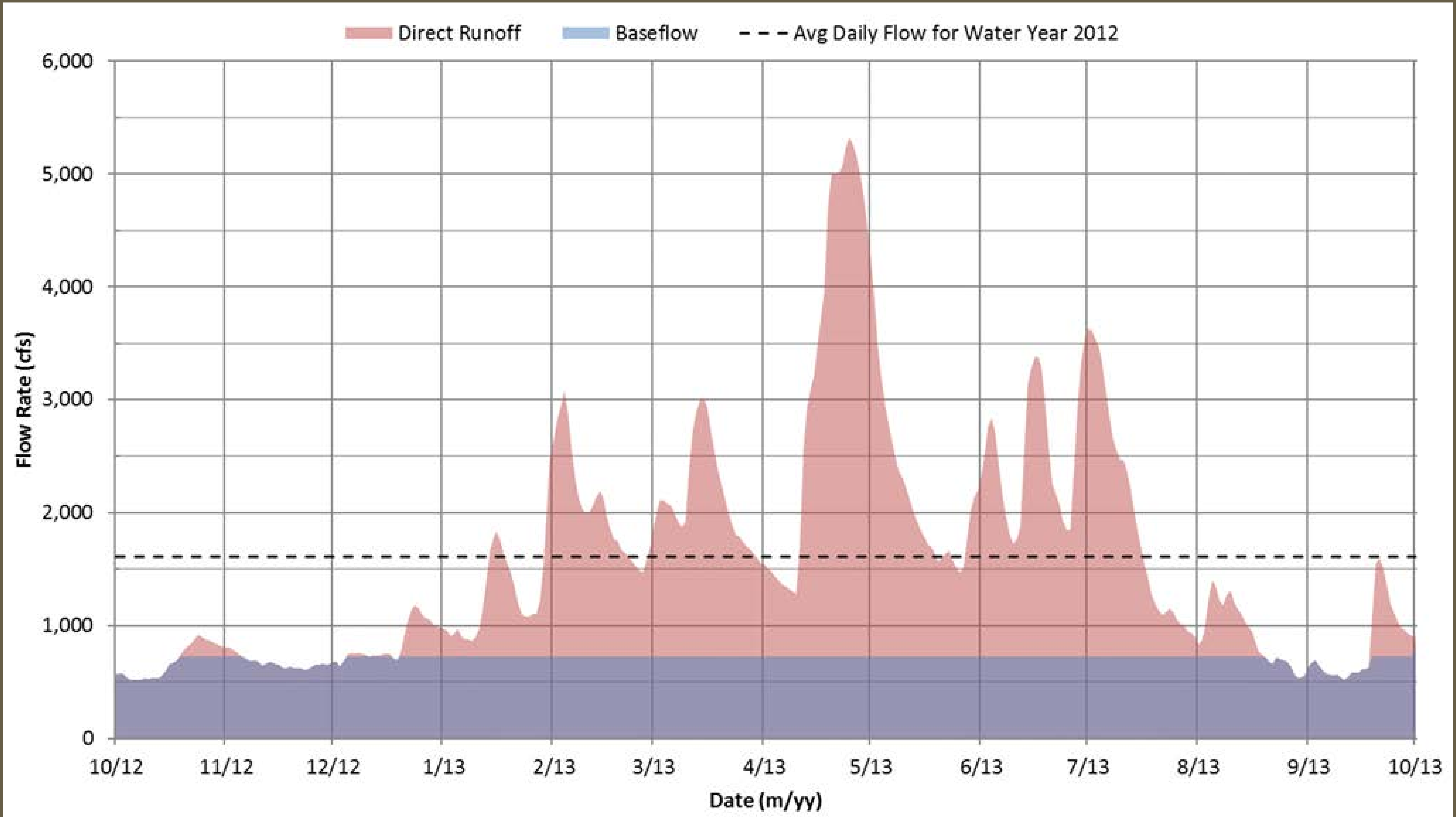
Summary of Likely Culprits:

1. More frequent, more intense Precipitation
2. Increased, uncompensated runoff from urban areas (impervious surfaces) and agricultural fields (drain tiles, pumping, preventing flood storage,…)
3. Activities in the River Corridor (berms next to the river and on the laterals, crossings, floodplain filling, temporary sediment wedges from high sediment load)

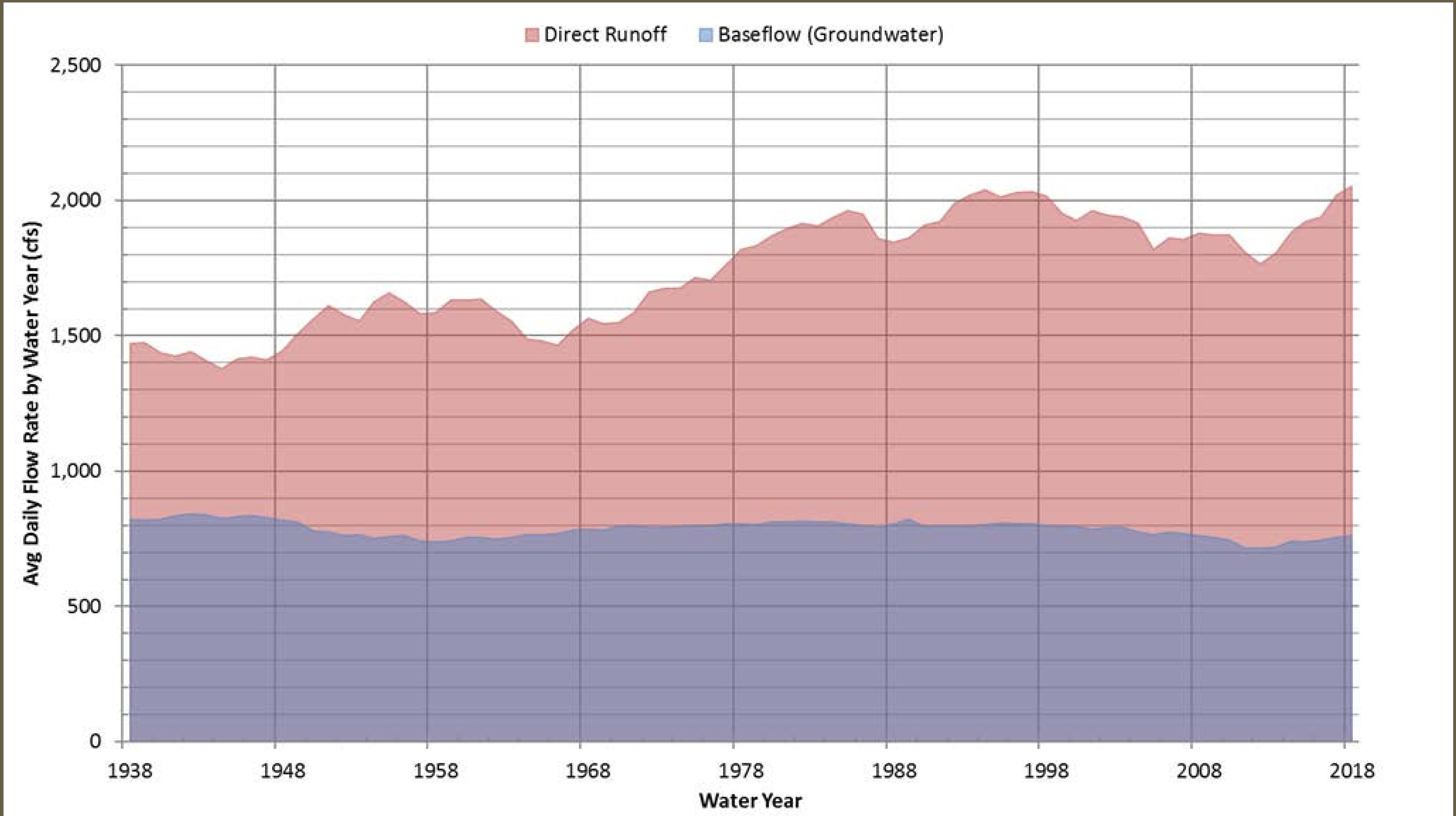


Number of Days above Moderate Flood Stage near Shelby Gage
No of Days above Flood Stage
15 per. Mov. Avg. (No of Days above Flood Stage)
Linear (No of Days above Flood Stage)
Number of Days above Moderate Flood Stage
Water Year
0
10
20
30
40
50
60
70
1923
1933
1943
1953
1963
1973
1983
1993
2003
2013

Direct Runoff Versus Base Flow on a Typical Year

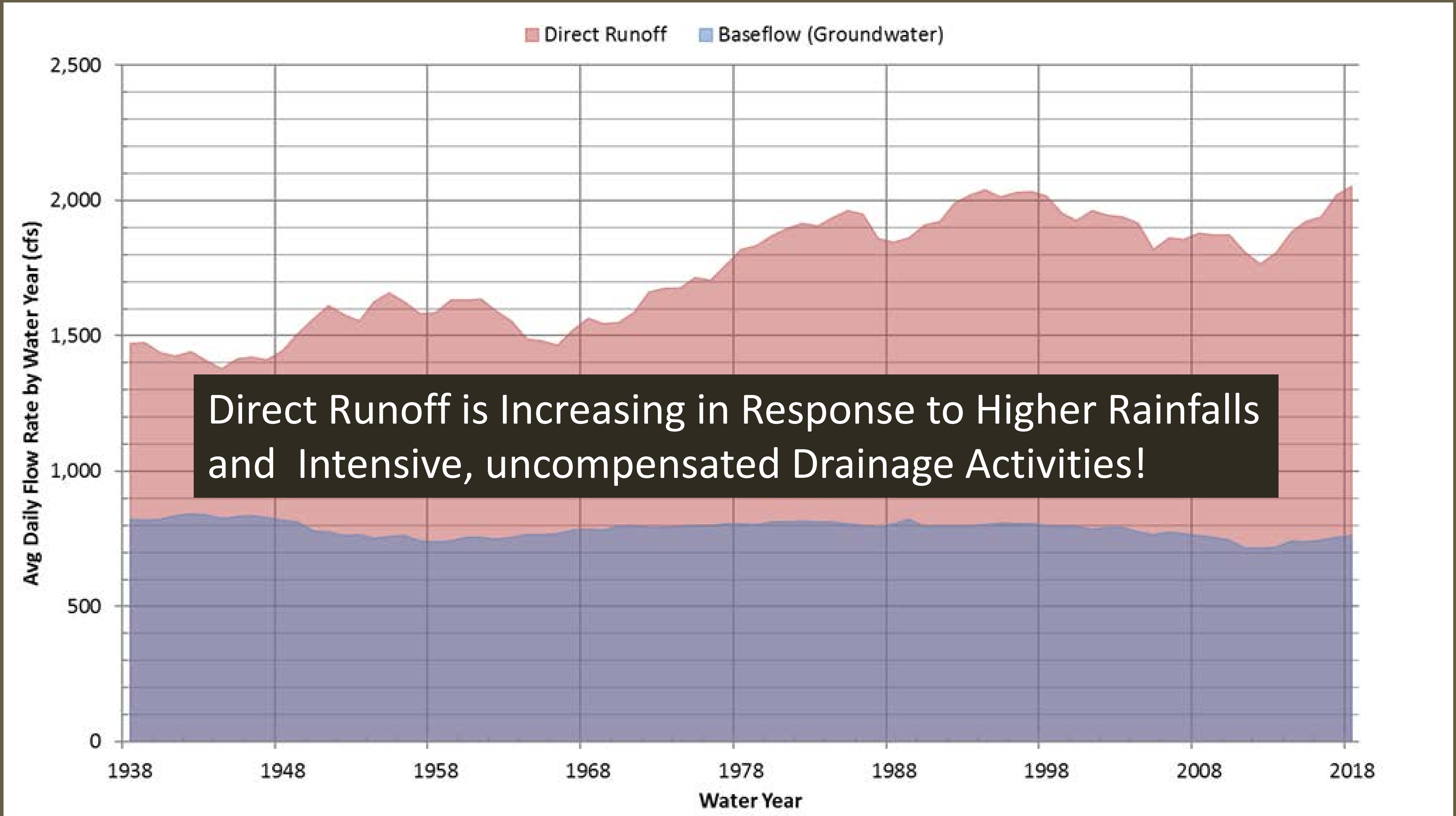


Observed Runoff Volume Increases at Shelby USGS Gage (Historical Trend of Average Flow Rates by Source)



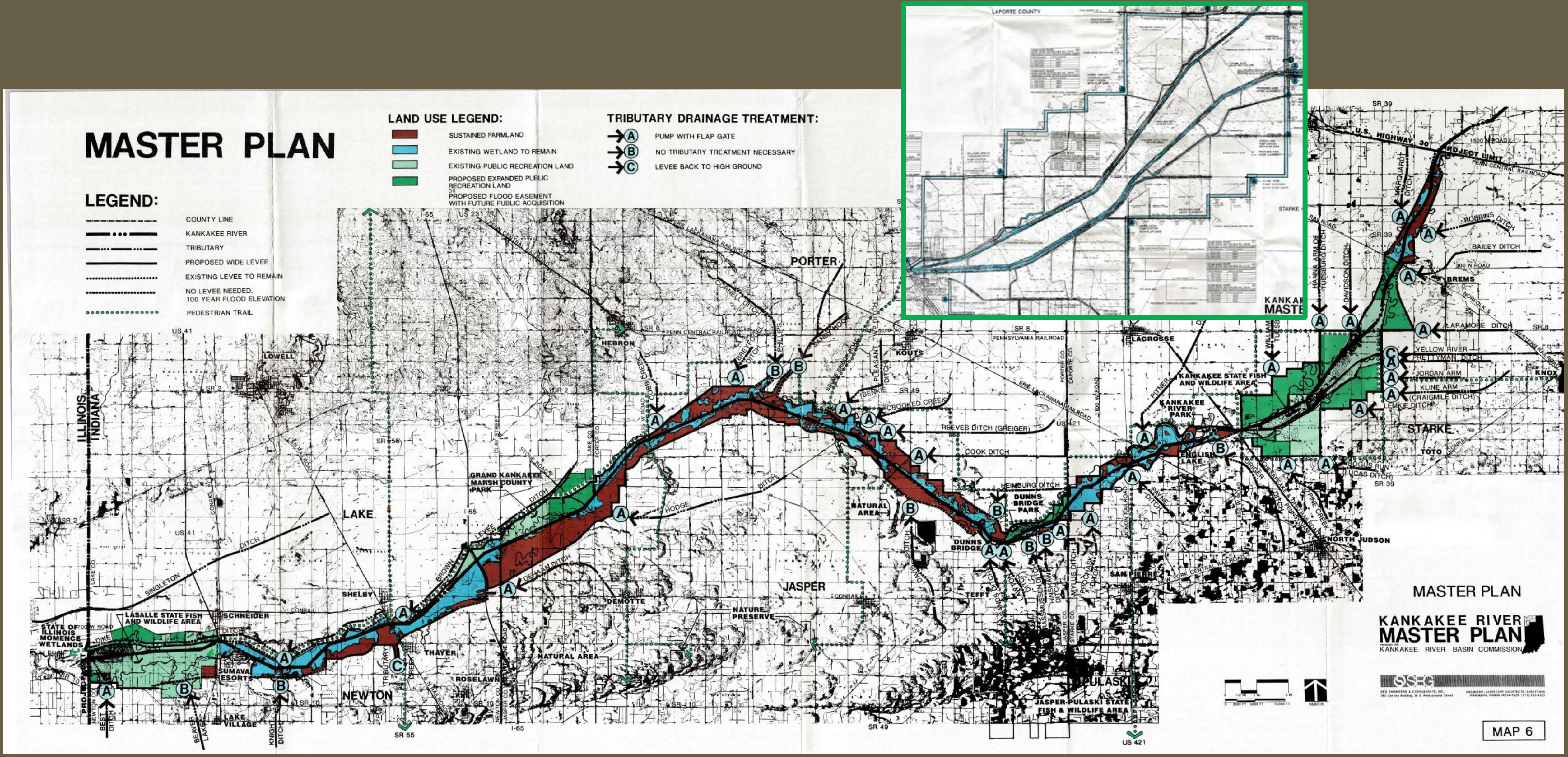
* Values Plotted are 15-Year Moving Averages

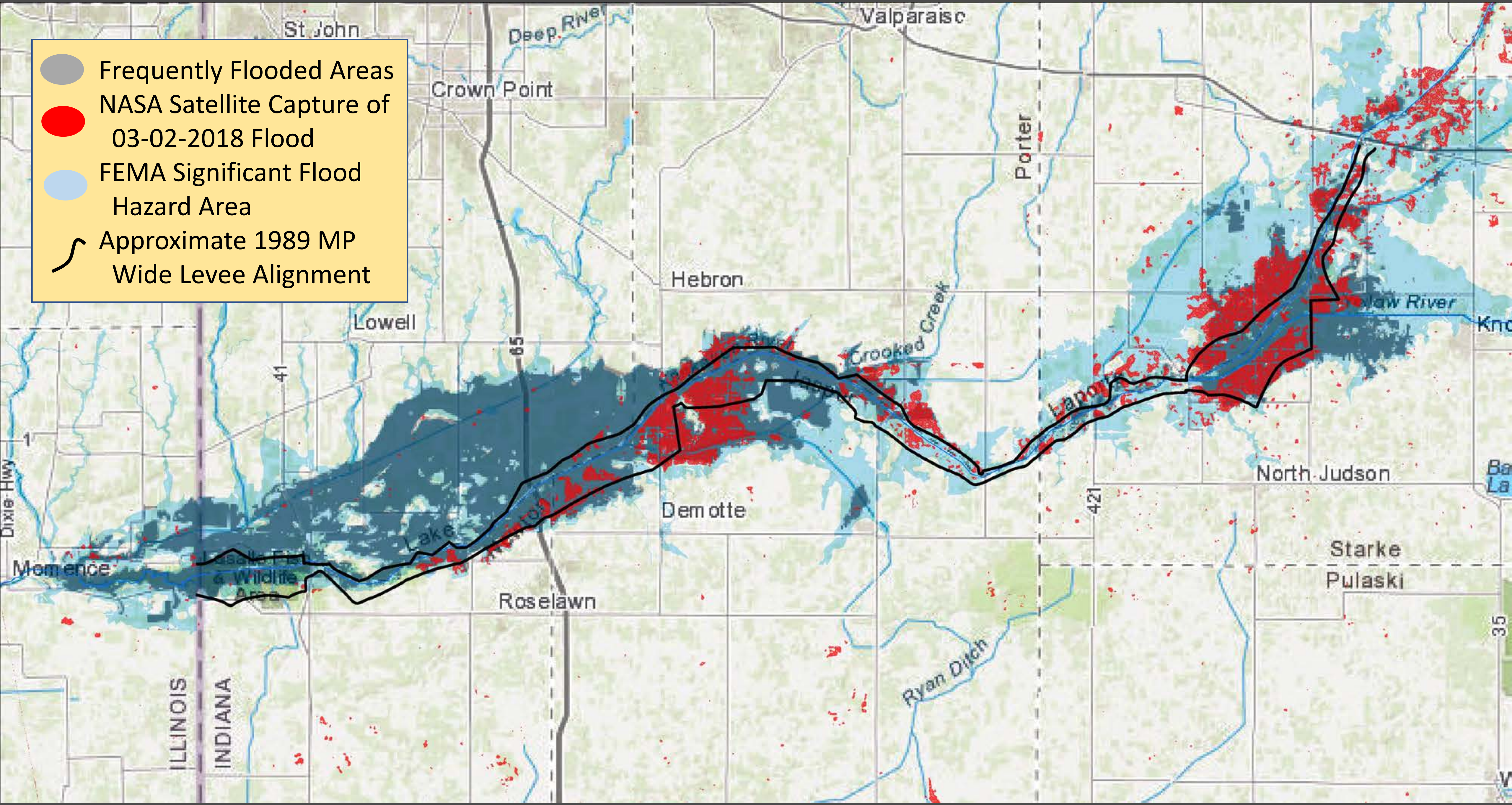
Observed Runoff Volume Increases at Shelby USGS Gage
(Historical Trend of Average Daily Flow Rates by Source)



* Values Plotted are 15-Year Moving Averages

Proposed Refined 1989 MP Wide Levee Alignment





Frequently Flooded Areas
NASA Satellite Capture of
03-02-2018 Flood
FEMA Significant Flood
Hazard Area
Approximate 1989 MP
Wide Levee Alignment
St John
Deep River
Valparaiso
Crown Point
Porter
Hebron
Lowell
Crooked Creek
Kankakee River
65
41
Demotte
North Judson
421
Starke
Pulaski
Momence
Roselawn
Ryan Ditch
Dixie Hwy
ILLINOIS
INDIANA

Summary of Findings to Date

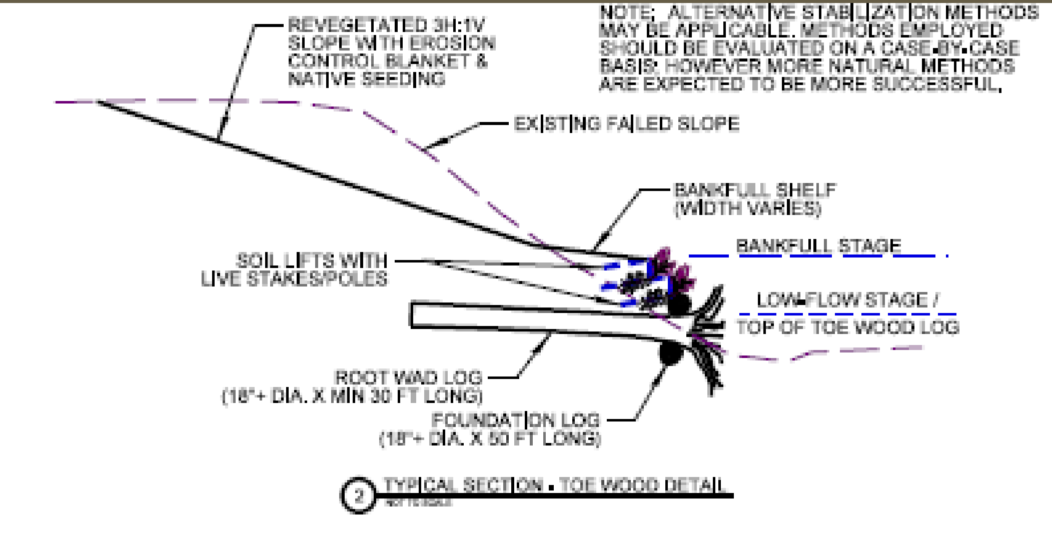
- The Greatest Source of Sediment into Kankakee River:
  - Bank Erosion along the banks in Yellow River from Knox to Marshall County
  - Bank Erosion along spoil piles in Kankakee River in Jasper, Porter, and Newton Counties
- The River is appropriately transporting the sediment downstream
  - Natural aggradation occurs in two flat spots (English Lake reach in Yellow River and Stateline reach in Kankakee River) due to more incoming sediment than these reaches can handle
- The Kankakee River channel is stable and any disturbance to it (such as dredging) will only create new instability problems!
- Spoil banks are not continuous and do not appear to provide meaningful flood protection during large floods. There are a lot of misconceptions about the role of these spoil piles!
- Major access and stability issues prevail along spoil banks, where they exist
- Due to large flood volumes, it is not feasible to contain the river within a narrow corridor (especially given the increasing peak flow trends)
- Maintenance of spoil banks this close to the river is not sustainable
- Temporary storage of floodwaters has and will continue to occur on wetlands, farmlands, and low-lying areas within the floodplain, as expected
- The problem is not the lack of flood storage, but the lack of land use compatibility!

Flood Control Alternatives are Limited!

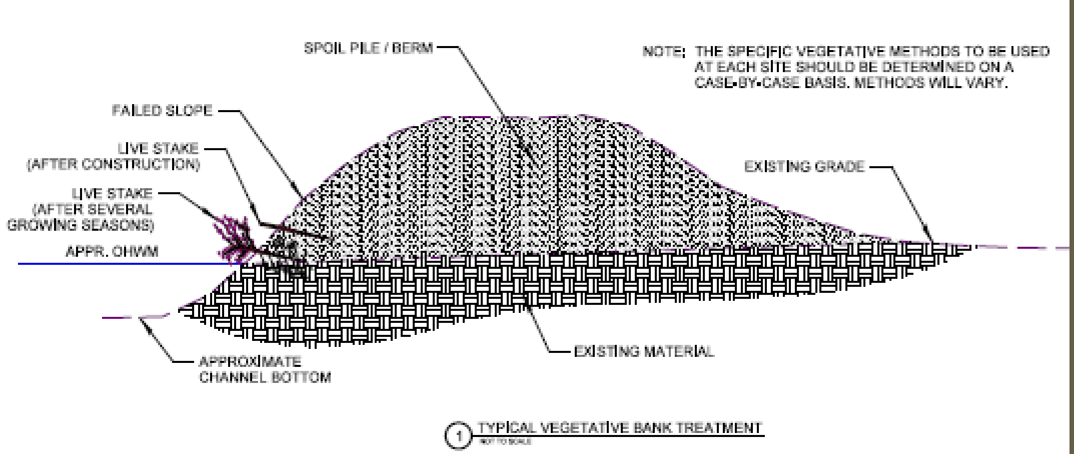
- What about dredging the channel?
  - Regardless of its recurring costs or permitability issues, dredging the channel cannot make up for loss of such a large required flood storage and also is not effective in a sand bed river system
  - Dredging also has several unintended consequences!
- What about repairing spoil banks, and making them taller?
  - The spoil piles were never meant to control flooding and do not constitute a continuous line of protection
  - Even if they could be made continuous and regardless of recurring maintenance costs and permitability issues, there is no way to contain so much flow volume within a narrow corridor
- The only feasible alternative is flood preparedness and to **give room to the river!**

Active Management Recommendations

1. Reduce Sediment Supply from Yellow River Upstream of Knox
   – Utilize concepts used in Pilot Project
   – Reduces sediment supply and temporary aggradations along the River
   – Highest priority in terms of benefit to the Kankakee River system



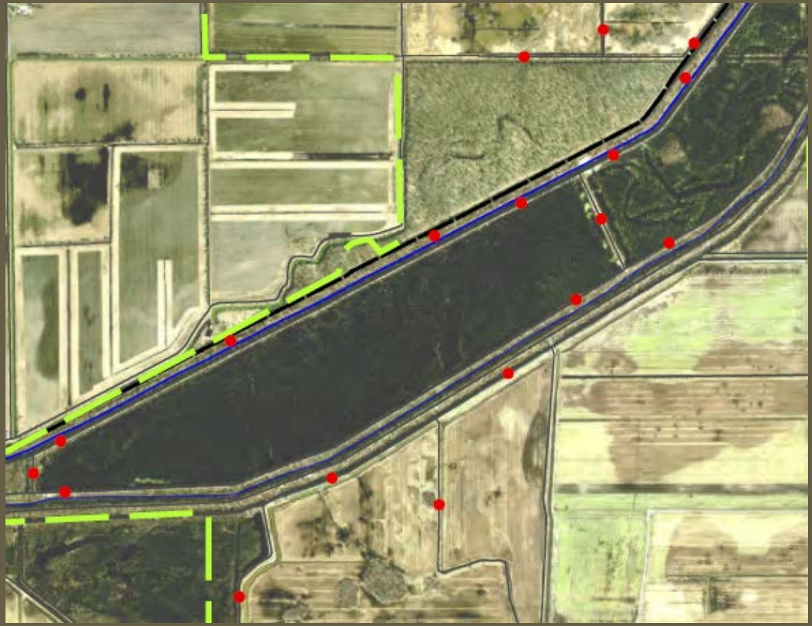
2. Reduce Sediment Supply from Severely Eroded Kankakee Slopes
   – Utilize vegetative methods to keep sediment from falling into the River
   – Second highest priority in terms of benefit to the Kankakee River system



Active Management Recommendations (cont.)

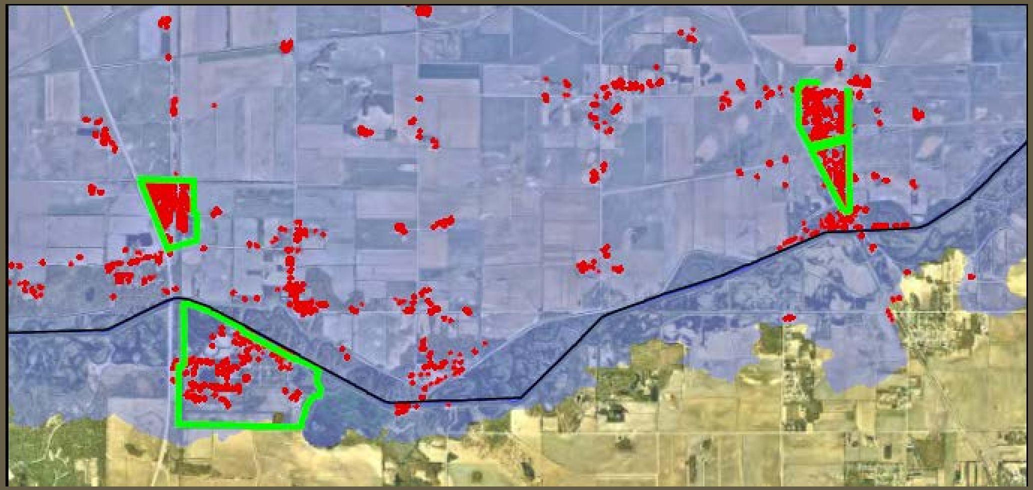
3. Stop Maintaining and Strategically Create Openings in Spoil Piles/Berms
   - Connect river to its floodplain for improved conveyance, storage, and sediment distrib.
   - Compensate ag lands if they were substantially protected from flooding through flood easement
   - Re-establish protection (if any) to critical facilities, major roads, or residential clusters

4. Create Openings in Internal and External berms at the Kankakee Fish and Wildlife Area
   - Allow free exchange of water between Kankakee and Yellow during flooding
   - Remove the need for active management and the guessing game by State in response to flood events

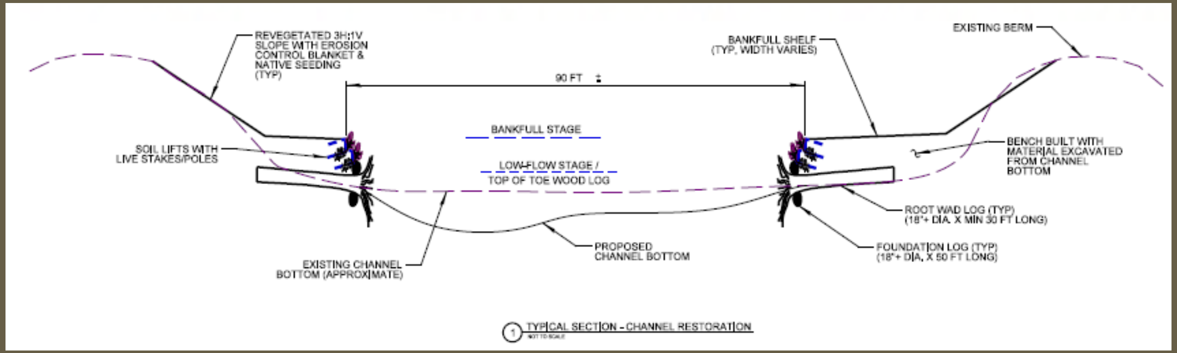


Active Management Recommendations (cont.)

5. Provide Strategic Flood Protection to Critical Facilities & Key Infrastructure
   – Construct engineered levees/perimeter berms to protect major facilities, roads, or dense residential clusters
   – Strategic approach is needed due to inability to eliminate flooding everywhere
   – Adverse impact to other properties should be addressed as part of design

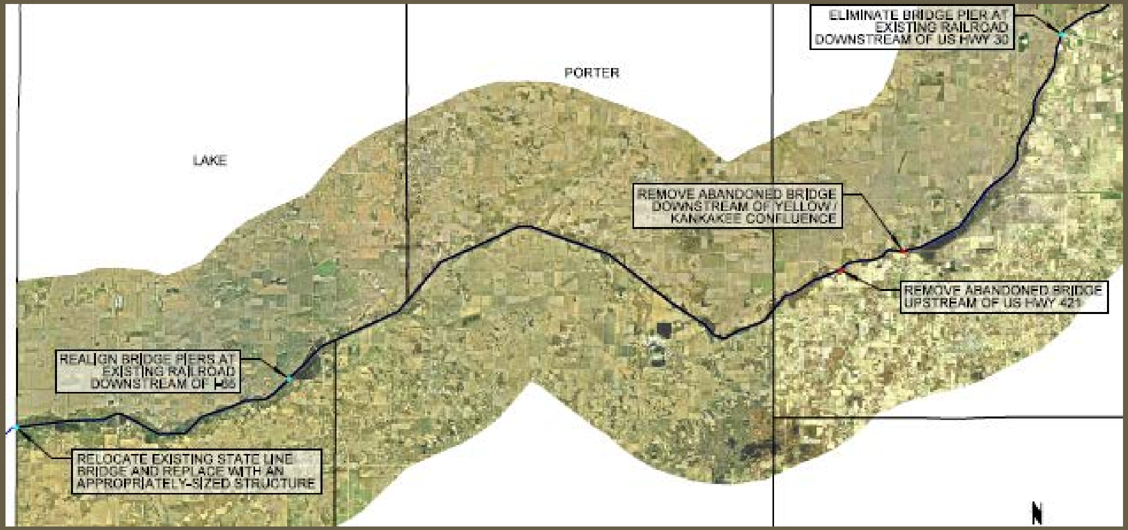


6. Restore Yellow River Sediment Transport Capacity Downstream of Knox
   – Utilize concepts used in Pilot Project to promote effective sediment transport
   – Monitor the impact of proposed upstream sediment supply reduction prior to designing downstream improvements

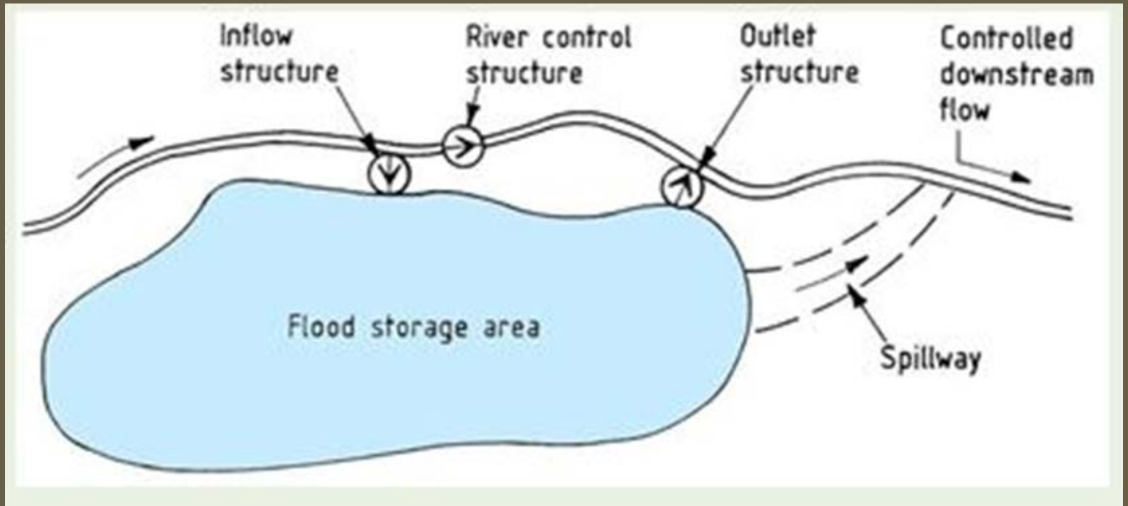


Active Management Recommendations (cont.)

7. Remove and/or Replace Restrictive Bridges
   - Several active and abandoned bridges are interrupting the sediment flow and cause flow backup
   - Need to garner legislative support at federal and state levels to deal with relocation of historic bridges

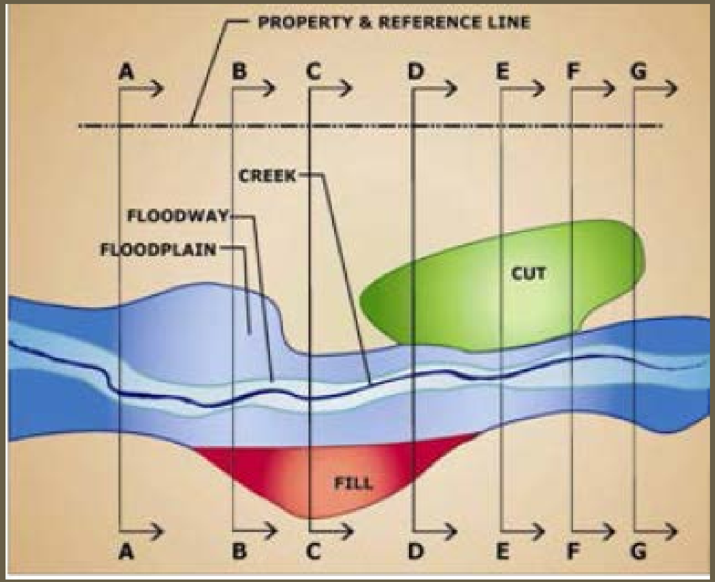


8. Construct off-line Retention or detention storage areas along Laterals
   - Needed to offset increase in runoff due to past and ongoing land drainage activities in the watershed and/or increased rainfall
   - Future drainage improvements by farmers or Drainage Boards should incorporate detention storage as part of improvement



Passive Management Recommendations

1. Update Stormwater Ordinance and Technical Standards for New Development
   - Several entities already have some form of control measure, but not consistent
   - Need to include NAI Measures:
     - Detention with pre-calculated maximum allowable release rates for each sub-watershed
     - Channel Protection Volume retention
     - 1.5:1 compensatory floodplain storage
     - No development within floodways and erosion corridors
     - Incentives for using LID and Green Infrastructure



2. Promote/Require Farm Drainage Impact Reduction Measures
   - Needed to offset the impacts of surface ditching and subsurface tiling on increased runoff in the River
   - Example of impact reduction measures:
     - Soil health conservation practices
     - Agricultural drainage management structures
     - 2-stage Ditches
     - Detention/Retention

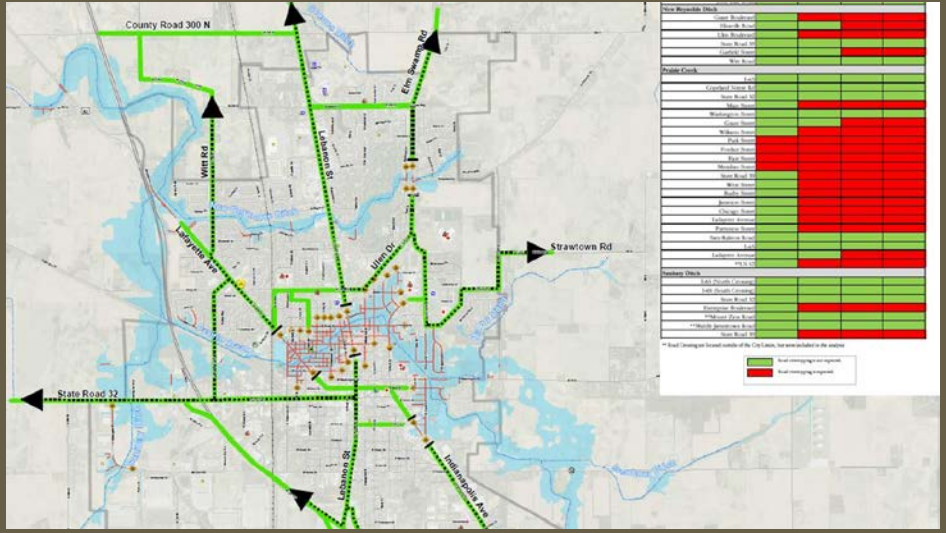
With Cover Crop

Without Cover Crop

Passive Management Recommendations (cont.)

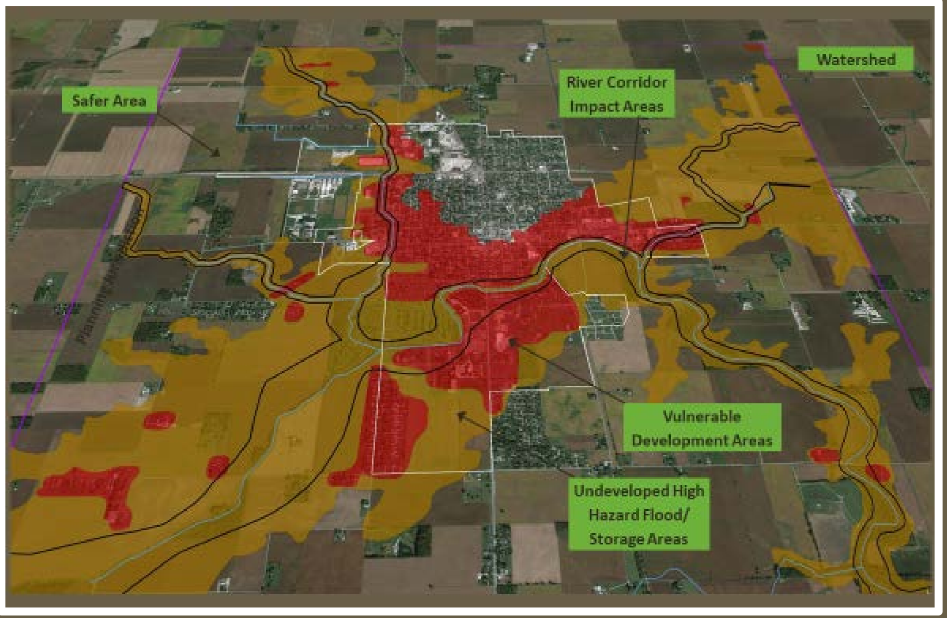
3. Develop Flood Response Plans

- Flooding, such as that observed in 2018, cannot be prevented
- Flood Response Plans help emergency responders with forecasting, detecting, classifying severity, and warning & evacuation priorities associated with an event
- IDHS & OCRA may be able to help fund these plans

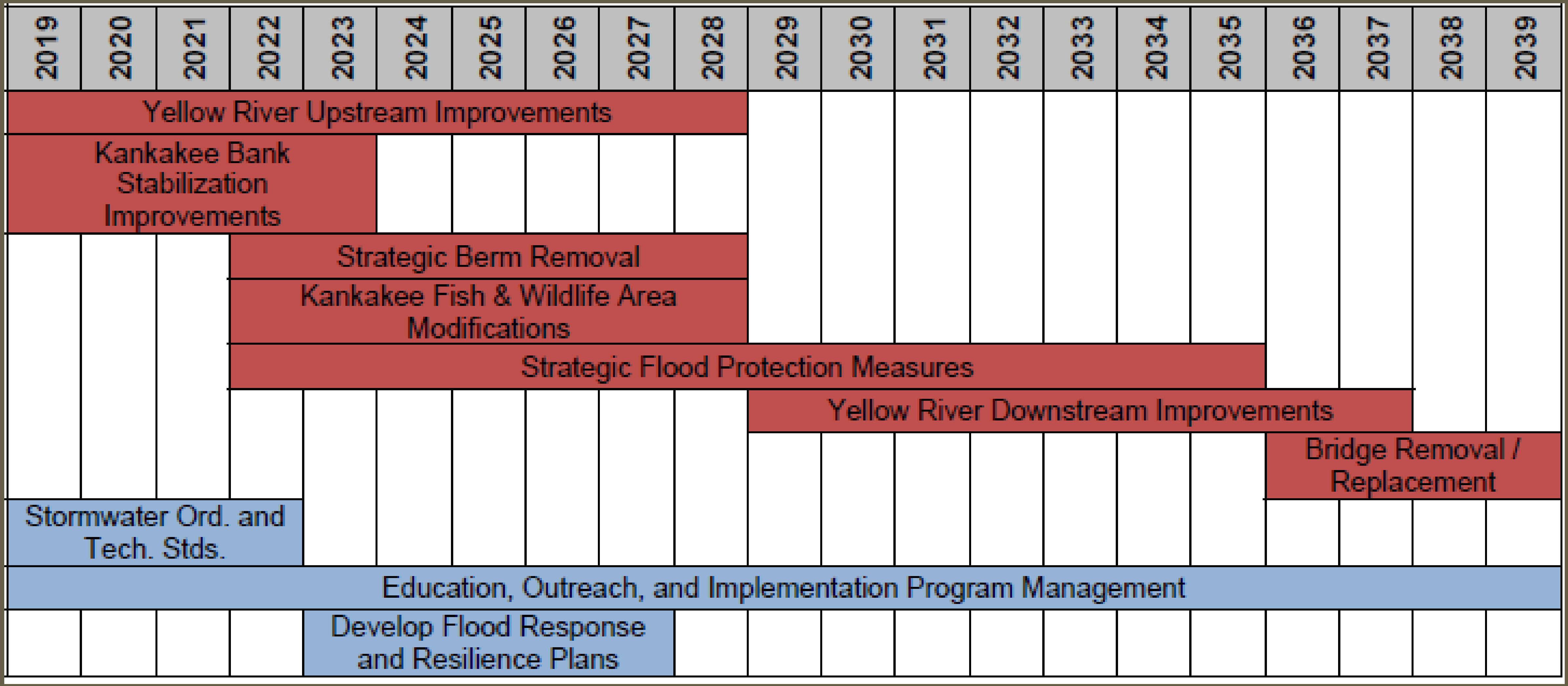


4. Develop Flood Resilience Plans

- Strategies are needed to curb increase in flood vulnerability
- Most effective resilience plans offer geographical-specific resilience strategies
- FEMA, IDHS, & OCRA may be able to help fund these plans



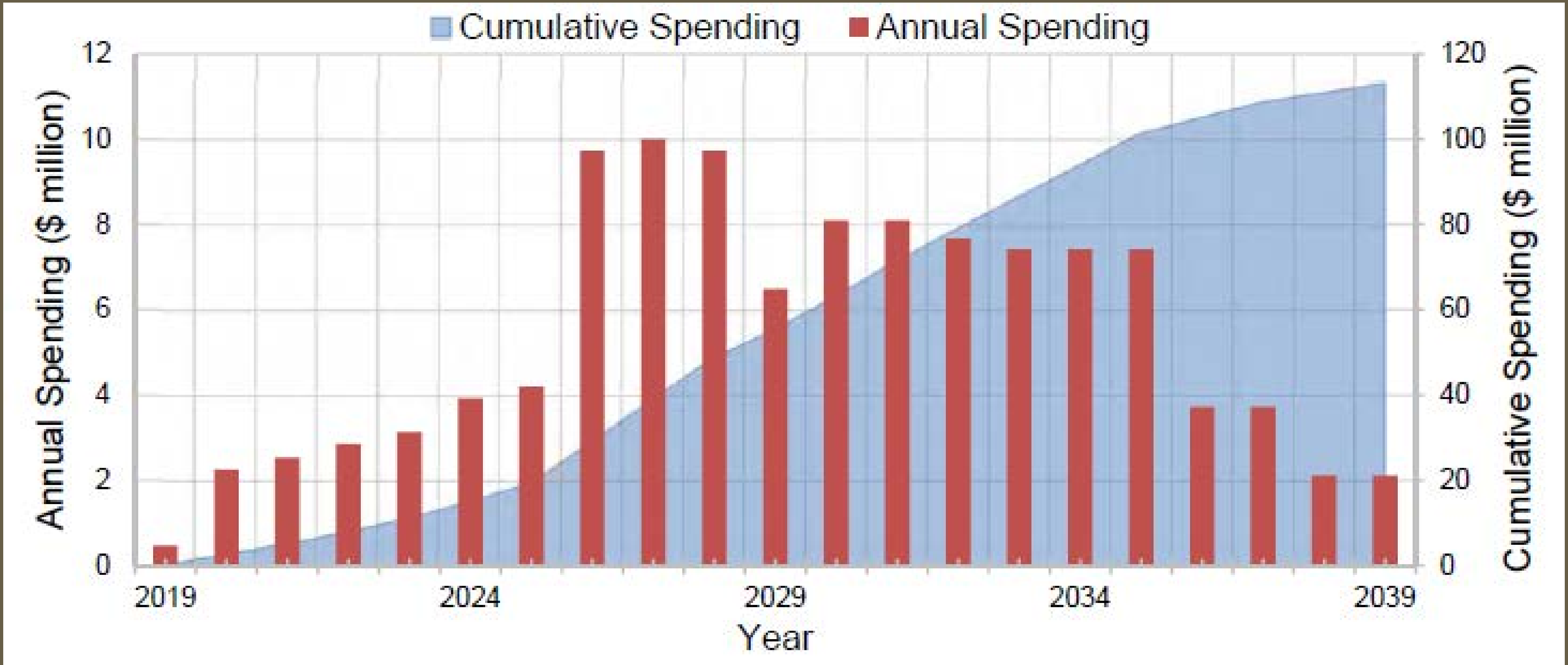
Implementation Sequence/Timeline



Notes:

1. The implementation sequence is based on system priority and available funding & manpower. Several of the measures can be initiated and can proceed concurrently, if feasible and advantageous
2. The implementation horizon can be shortened if annual funding is not limited

Annual Funding Need Projections



Notes:

1. The cost estimates and annual funding needs are interim, preliminary, and subject to change
2. The implementation horizon can be shortened if annual funding is not limited

Expected Outcomes

- Significant Reduction in Sediment Supply
  - Helps preserve and improve drainage capacity in the River
  - Helps reduce temporary sediment slugs and wedges during flood events, thus reduces flood stages
  - Helps reduce supply of sand deposited on fields during large out of bank floods
- Efficient, Unrestricted Access to Floodplain Storage
  - Lowers the flood stages due to additional accessed storage and conveyance paths
  - Helps distribute sand evenly along the length of River and combined with sediment supply reduction, reduces sand pile ups on adjacent land during flooding
  - Reduces flood inundation duration along the River by eliminating entrapments behind berms
  - Eliminates costly and unsustainable maintenance of berms/spoil piles along the River
- Improved, Consistent Sediment Transport
  - Combined with sediment supply reduction, helps reduce temporary sediment slugs and wedges downstream during flood events
- Strategic Flood Protection of Critical Facilities, Major Transportation Routes, and Dense Residential Clusters
  - Provides reliable, engineered flood protection to critical facilities, major transportation routes, and residential clusters
- Increased Flood Storage in the Watershed
  - Recommended watershed-wide cover crops, detention basins along laterals, 2-stage laterals would create additional storage in the watershed, reducing the flow to the River
- Keeping Flood Peak Discharges, Volumes, and Stages from Increasing Further
  - Updated, NAI Stormwater Ordinance and Standards help prevent additional increases in runoff and peak stages
- Institution of Flood Preparedness and Flood Resilience Culture
  - Helps emergency responders with tools for flood detection, warning and evacuations, and road closures
  - Helps change community officials mindsets in allowing an increase in vulnerability and to institute resilience measures

QUESTIONS?

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